LIGHT GAS GUN DATA SHEET

Shot No. 396 Date 1/29/10

Target:

Sample Material FAYALITE Crystallographic orientation _____

Source Location Univ. of Michigan powder Thickness:1 _____ in.

Type of Measurement HEATING - EOS @ 1300°C 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. Driver Plate Thickness _____ in.
(shim to driver) Material _____

Projectile:

Weight 24.997 gms. Length 0.9036 in. Skirt Diameter 1.1119 in.

Flyer Plate Material Ta Leading Edge Dia. 1.0998 in.

Thickness 1.496 ~~in.~~ mm Major Dia. 0.998 in. Depth Inserted 3 in.

Minor Dia. 0.953 in. @ 100 to 120 lbs of force

Barrel Dimensions:

Breech Diameter 1.1096 in. Muzzle Diameter 1.1013 in. Taper 0.0083 in.

Ellipticity @ projectile depth insertion point 0.0001 in.

Piston:

Weight 6.627 lb. Length 20.5 in. O-ring Groove Depth 0.111 in.

Diameter: Front 3.496 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure -30 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 623 gms. Type IMR 4350 Total Charge 635 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 5.0 km/sec Piston 0.64 km/sec

Notes: 1300°C @ shot time 5.3KV 8:45 heating cycle
Shot streak is good, but dim.

L.G.G.

Camera Streak Duration: 1513 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 1500 198

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 3.10 µsec Flash X-ray #2 73.73 µsec

Static Streak Photo 78 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0539 in. min.	0,936 in. min.
0.0550 in. max.	0,940 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 85/65 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.50 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.632 km/sec

Piston Velocity from Gauge #1 to #3: 0.633 km/sec

Projectile Velocity from UDC: 5000.28 m/sec

Projectile Velocity from X-ray: _____ km/sec

5002 m/s

L.G.G.

COUNTER CONNECTIONS

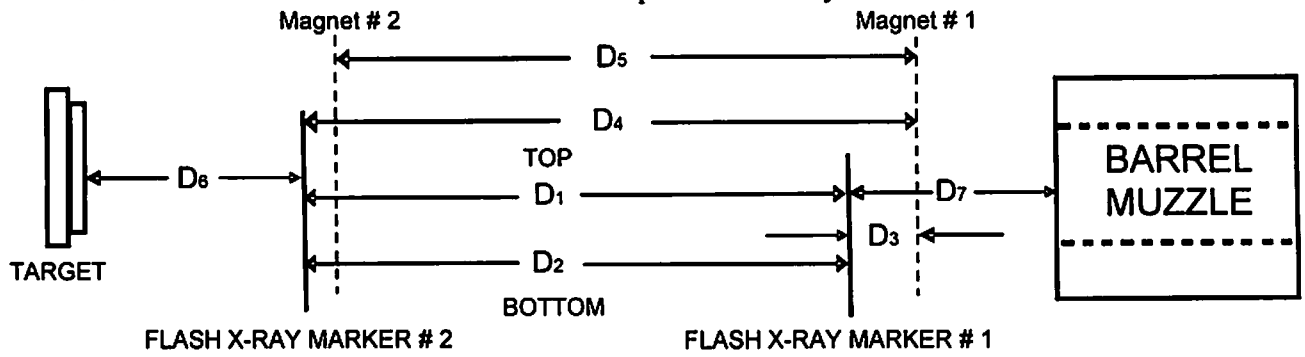
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	482 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	963 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	40.8 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	70.582 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	76.787 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	6.211 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	70.609 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	40.72 µsec
UDC Velocity:			5000.28 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 (23.3V pp, 2.5206)	Velocity magnet 2 (43.2662)	40.745 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start 4.8784	2.358 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop 45.5898	2.324 µsec
HP6, 1-2:	Velocity Magnet 1	Xenon Lamp Trigger	— µsec (HP6-2 turned off)
HP6, 3-4:	X-ray 1 Pulser Monitor Out (8.5658)	X-ray 2 Pulser Monitor Out (79.1718)	70.606 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	82.435 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	82.720 µsec
HP3-4	TTL Start	TTL Stop	40.711 µs

TARGET MEASUREMENT

Shot No. **396** Expected Velocity: **5.00** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	35.0	99.0
Measure # 2, mm	30.00	383.15	203.66	35.0	99.0
Average, mm	30.00	383.15	203.61	35.0	99.0
Travel time, µsec	**6.00**	**76.63**	**40.72**	**7.00**	**19.80**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **70.64** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

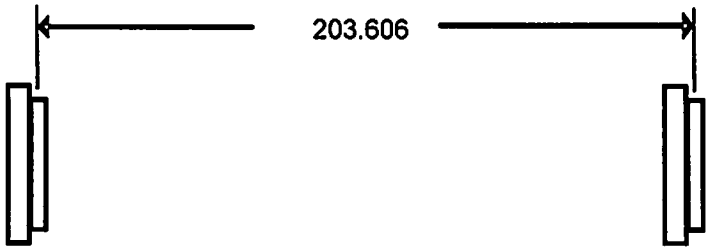
Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **70.62** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **3.10** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **73.73** µsec.

MAGNET DISTANCE

Shot No. **396** Expected Velocity: **5.00**



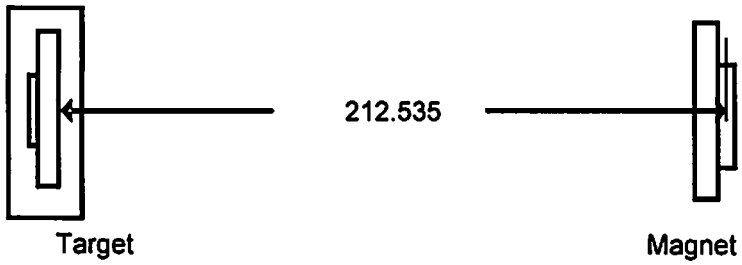
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **40.721 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.243 inch

Second measurement = 8.242 inch

Average measurement = 8.243 inch

Average measurement = 209.360 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

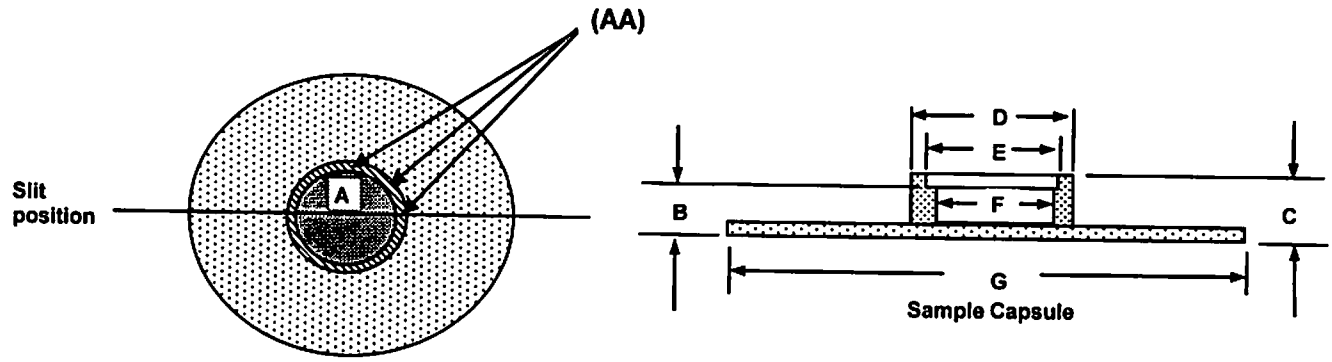
Distance Between Magnet # 2 to Target = 212.535 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **42.507 µsec.**

Fudged Distance between Magnet 2 to Target = 0 mm

SHOT No. _____396_____ (pre- polish)
SAMPLE CAPSULE: ____#12 _____
SAMPLE MATERIAL: Molybdenum

Cap(see attached sheet)



Before Sample Assembly

DIGITAL DEPTH GAUGE
THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap should be also polish.

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

A	0.08235
A	0.08240
A	0.08265
A	0.08255

avg 0.08249"
2.095mm

C	0.21155
C	0.21175
C	0.21195
C	0.21195
D	0.3950
D	0.3950

B point 1(top)	0.18255
B point 2	0.18250
B point 3	0.18235
B point 4	0.18230
B point 5	0.18220
B point 6	0.18220
B point 7	0.18245
B point 8	0.18245

DIGITAL CALIFER
DIAMETER MEASUREMENT

E	0.3665
E	0.3625
F	0.3225
F	0.3210
G	1.7480
G	1.7470

Statistics

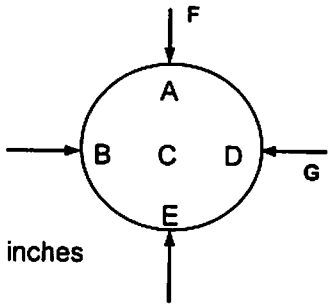
N	8
MAX	0.18255
MIN	0.18220
Range	0.00035

DENSITY MEASUREMENT BY: Russ on				2/20/2007		
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88969	36.45750	35.25807	0.8640	10.1967
2	21.8	1.88964	36.45751	35.25810	0.8640	10.1969
3	21.8	1.88959	36.45755	35.25810	0.8640	10.1969
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1968	1.49E-04	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	
	DENSITIES CHECKED BY:		Russ	2/20/2007		
	MEASUREMENT CHECKED BY		Russ	2/20/2007		

MATERIAL: Fayalite - Batch F - Sample A

Measurement done by: Russ O. **Date:** 8/19/2009

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT			
A	0.04030	F	0.30400		
A	0.04040	F	0.30550		
B	0.03995	G	0.30350		
B	0.04040	G	0.30300		
C	0.04055	**AVE**		**0.30400**	inches
C	0.04065				
D	0.04050				
D	0.04055				
E	0.04005				
E	0.04020				



Statistic for thickness

N	10	
MAX	0.04065 inch	1.03251 mm
MIN	0.03995 inch	1.01473 mm
Range	0.00070 inch	0.01778 mm
MEAN	0.04036 inch	1.02502 mm
STDEV	0.000216712 inch	0.00550 mm

Statistic for Diameter

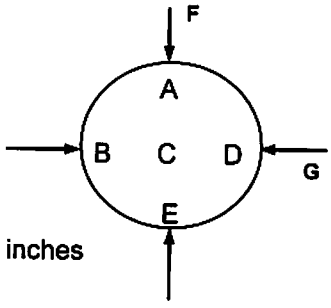
N	4	
MAX	0.30550 inch	7.75970 mm
MIN	0.30300 inch	7.69620 mm
Range	0.00250 inch	0.06350 mm
MEAN	0.304 inch	7.72160 mm
STDEV	0.001080123 inch	0.02744 mm

DENSITY MEASUREMENT BY: Russ Oliver						
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	20.0	1.88447	0.18342	2.03122	0.8656	4.3299
2	20.0	1.88448	0.18346	2.03126	0.8656	4.3296
3	20.0	1.88446	0.18347	2.03124	0.8656	4.3287
	THICKNESS:		0.04036	±	mm	
	FLATNESS:		0.00070	mm		
	VOLUME:		0.0480	0.0039	cm^3	
	CRYSTAL DENSITY:		4.3294	0.0006	$grams/cm^3$	
	BULK DENSITY:		3.8219	0.0039	$grams/cm^3$	
	DENSITIES CHECKED BY: _____Russ					
	MEASUREMENT CHECKED BY: ___Russ					

MATERIAL: Fayalite - Batch F - Sample B

Measurement done by: Russ O. **Date:** 8/19/2009

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT			
A	0.04790	F	0.30600		
A	0.04790	F	0.30650		
B	0.04830	G	0.30600		
B	0.04840	G	0.30650		
C	0.04850	**AVE**		**0.30625**	inches
C	0.04845				
D	0.04810				
D	0.04825				
E	0.04825				
E	0.04825				



Statistic for thickness

N	10	
MAX	0.04850 inch	1.23190 mm
MIN	0.04790 inch	1.21666 mm
Range	0.00060 inch	0.01524 mm
MEAN	0.04823 inch	1.22504 mm
STDEV	0.000236039 inch	0.00600 mm

Statistic for Diameter

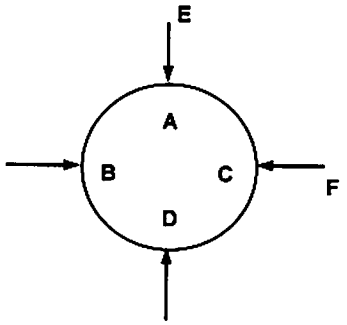
N	4	
MAX	0.30650 inch	7.78510 mm
MIN	0.30600 inch	7.77240 mm
Range	0.00050 inch	0.01270 mm
MEAN	0.30625 inch	7.77875 mm
STDEV	0.000288675 inch	0.00733 mm

DENSITY MEASUREMENT BY: Russ Oliver						
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.1	1.88573	0.22852	2.06771	0.8646	4.2455
2	21.1	1.88575	0.22854	2.06777	0.8646	4.2477
3	21.1	1.88575	0.22857	2.06772	0.8646	4.2409
	THICKNESS:		0.04823	±	mm	
	FLATNESS:		0.00060	mm		
	VOLUME:		0.0582	0.0012	cm^3	
	CRYSTAL DENSITY:		4.2447	0.0034	$grams/cm^3$	
	BULK DENSITY:		3.9256	0.0012	$grams/cm^3$	
	DENSITIES CHECKED BY: ____Russ					
	MEASUREMENT CHECKED BY: ___Russ					

SHOT No. _ 396
LGG Moly Capsule Cap
SAMPLE MATERIAL: Mo # 12 3/2/2009

Thickness Measurement

A	0.03005
A	0.03000
B	0.02990
B	0.02995
C	0.03015
C	0.03015
D	0.03020
D	0.03020



Diameter Measurement

E	0.35350
E	0.35350
F	0.35350
F	0.35300
AVE	0.353375
Radius	0.1767

Statistic for thickness

N	8
MAX	0.0302
MIN	0.0299
Range	0.0003
MEAN	0.030075
STDEV	0.000116496

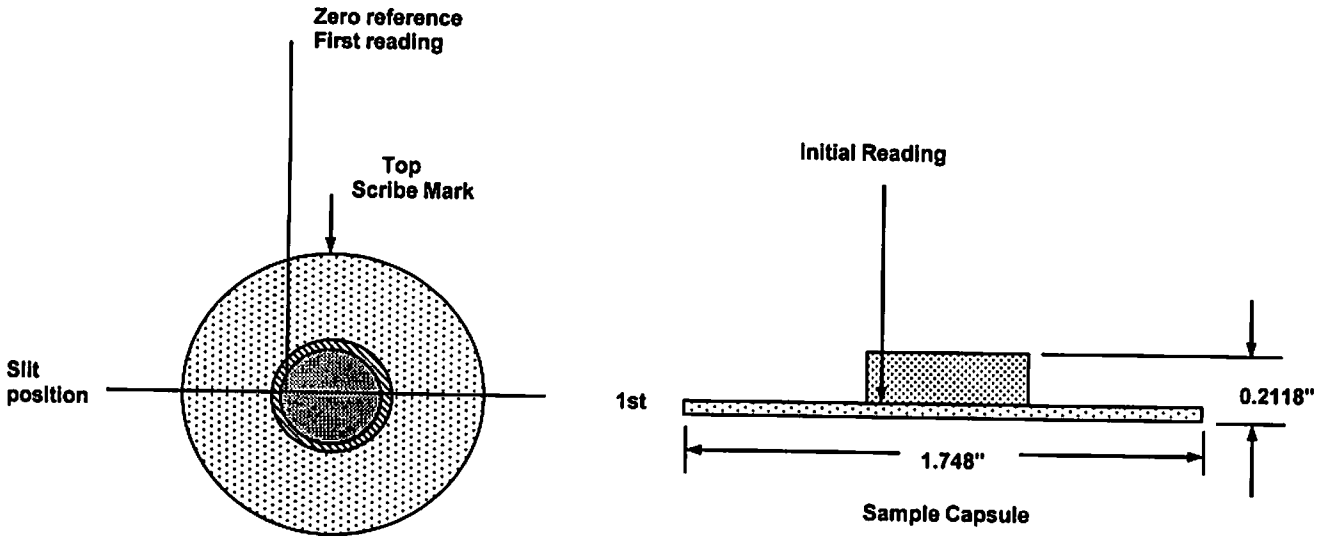
Statistic for perimeter

N	4
MAX	0.3535
MIN	0.353
Range	0.0005
MEAN	0.353375
STDEV	0.00025

DENSITY MEASUREMENT BY:			Russ	3/2/2009		
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	22.8	1.88251	0.48280	2.32439	0.8631	10.1829
2	22.8	1.88248	0.48288	2.32442	0.8631	10.1807
3	22.8	1.88248	0.48284	2.32440	0.8631	10.1837
	THICKNESS:		0.030075	±	mm	
	FLATNESS:		0.0003			
	VOLUME:		0.0483		cm^3	
	CRYSTAL DENSITY:		10.1824	1.54E-03	$grams/cm^3$	
	BULK DENSITY:		9.9893		$grams/cm^3$	
	DENSITIES CHECKED BY:			on		
	MEASUREMENT CHECKED BY:			on		

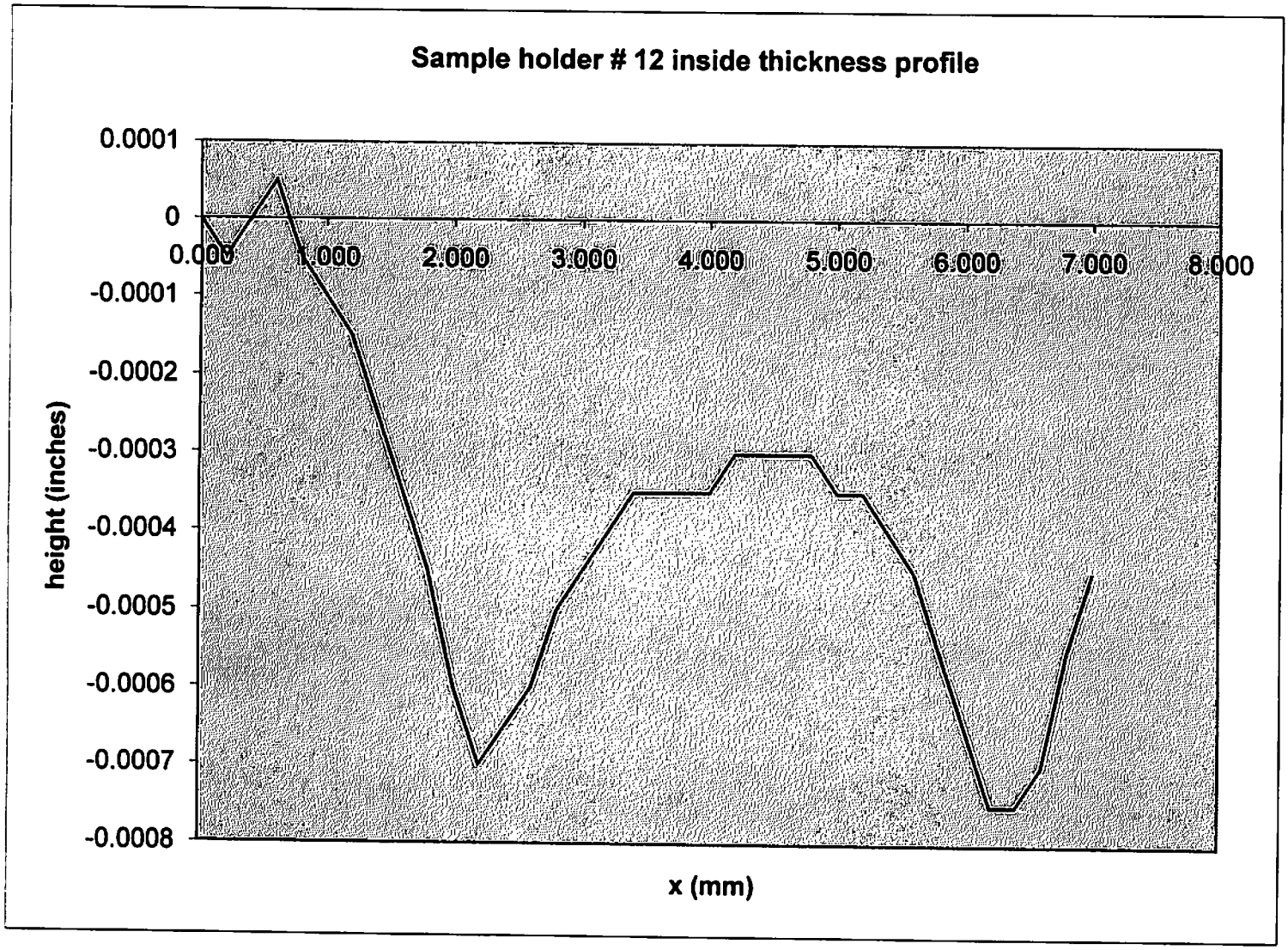
SAMPLE CAPSULE: 12
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER # 12



Average thickness reading = -0.00023

Note: The thickness of the reference zero point from the base is = 0.08330 Inches
2.11582 mm

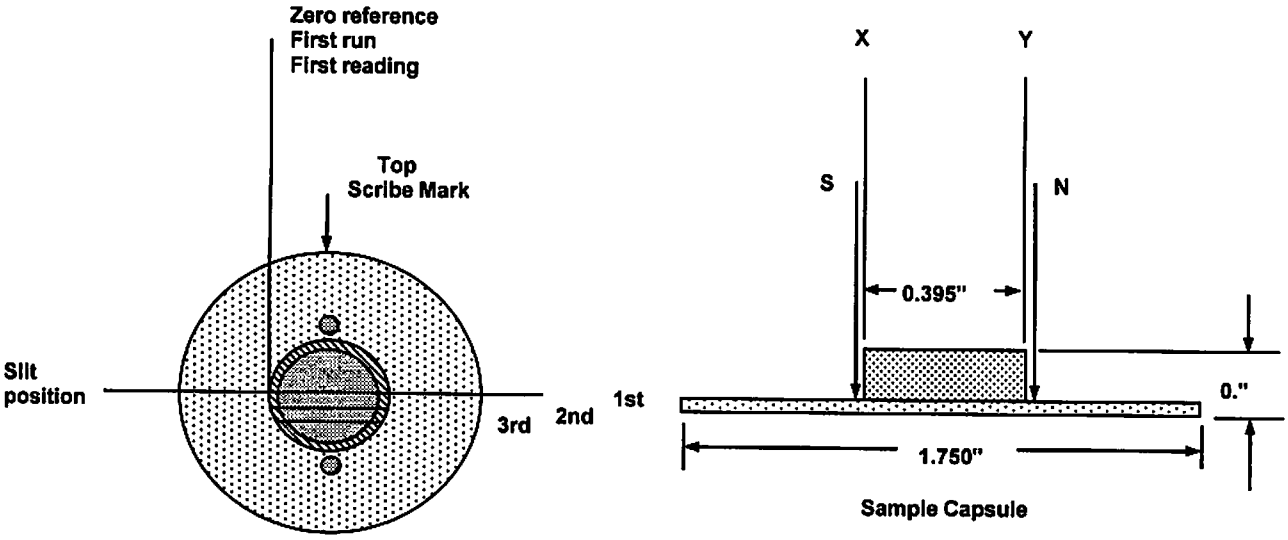

Sample holder # 12 inside thickness profile
0.0001
0
-0.0001
-0.0002
-0.0003
-0.0004
-0.0005
-0.0006
-0.0007
-0.0008
height (inches)
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
x (mm)

Thickness Measurement of the Samle Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches
1	0.000	0
2	0.200	-0.00005
3	0.400	0.00000
4	0.600	0.00005
5	0.800	-0.00005
6	1.000	-0.00010
7	1.200	-0.00015
8	1.400	-0.00025
9	1.600	-0.00035
10	1.800	-0.00045
11	2.000	-0.00060
12	2.200	-0.00070
13	2.400	-0.00065
14	2.600	-0.00060
15	2.800	-0.00050
16	3.000	-0.00045
17	3.200	-0.00040
18	3.400	-0.00035
19	3.600	-0.00035
20	3.800	-0.00035
21	4.000	-0.00035
22	4.200	-0.00030
23	4.400	-0.00030
24	4.600	-0.00030
25	4.800	-0.00030
26	5.000	-0.00035
27	5.200	-0.00035
28	5.400	-0.00040
29	5.600	-0.00045
30	5.800	-0.00055
31	6.000	-0.00065
32	6.200	-0.00075
33	6.400	-0.00075
34	6.600	-0.00070
35	6.800	-0.00055
36	7.000	-0.00045

SHOT N 396
SAMPLE CAPSULE: _____12_____
SAMPLE MATERIAL: Molybdenum (Anorthite # 4)

THICKNESS PROFILE (Polish)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = 0.00125

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = 0.00128

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = 0.00085

Note: The thicknessss of the reference zero point from the base is = 0.2151 Inches 5.4635 mm

The thicknessss of the reference zero point from the base is (North) = 0.0905 Inches 2.2987 mm

The thicknessss of the reference zero point from the base is (South) = 0.0900 Inches 2.2860 mm

Average thickness of the driver Plate = 0.0903 Inches 2.2924 mm

Thickness of the Carbon Deposited on the coil side is = 216.00 nm

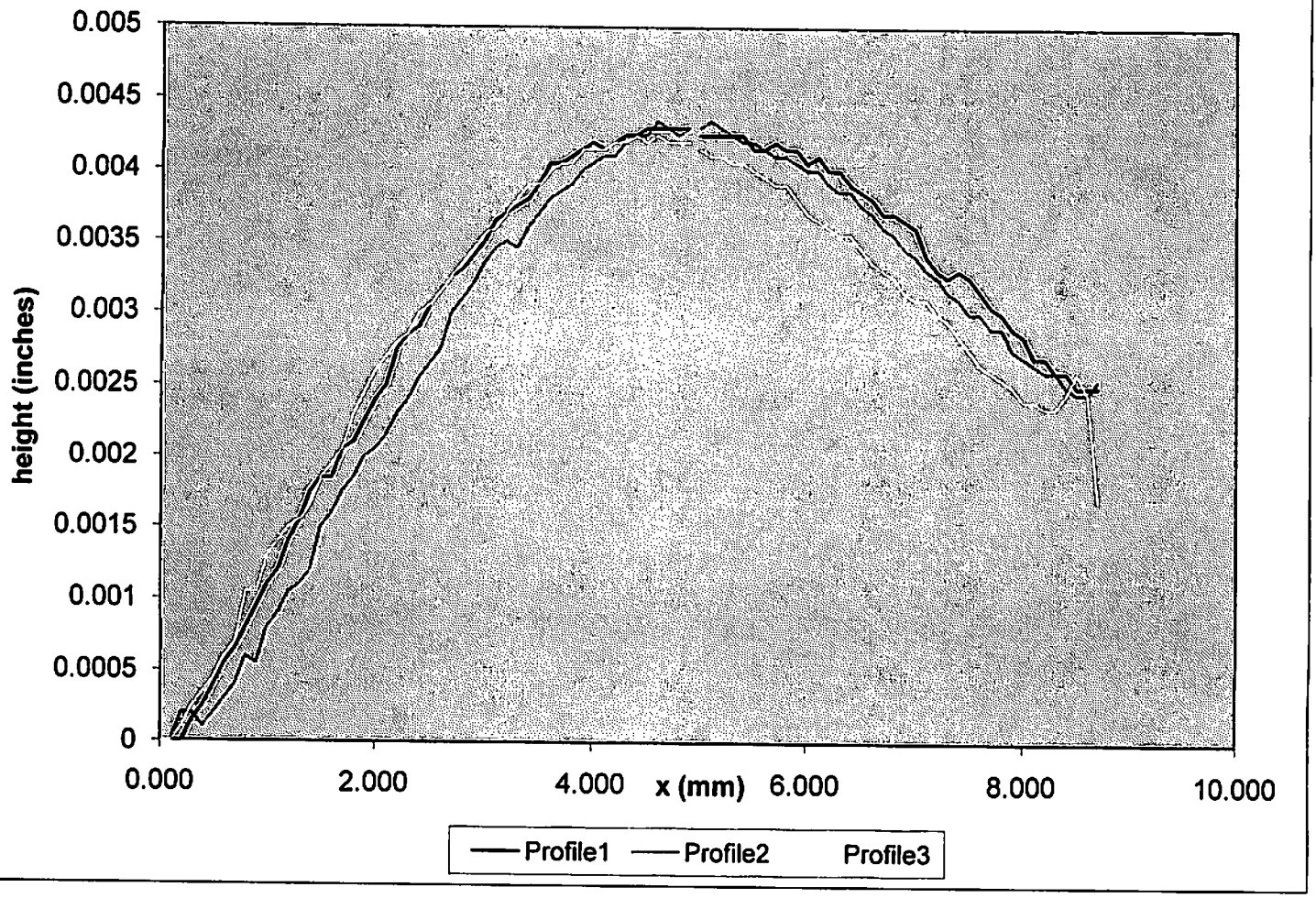
Thickness of the Carbon Deposited on the Projectile side is = 150.00 nm

Thickness from the top of the Cap to the polish portion of the inside part of the driver plate = 0.12 Inches 3.17 mm

1. First Run Horizontal (X) thru the center with 0.100 MM increment								
2. Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment								
3. Third Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment								
		1st	2nd	3 rd				
Number	Reading	Run	Run	Run	Number	Reading		
of	Distance	Reading	Reading	Reading	of	Distance	North	South
Reading	mm	Inches	Inches	Inches	Reading	mm		
1	0.000	0	0	0	1	0.000	0	0
2	0.100	0.00000	0.00000	0.00000	2	0.100	0.00010	0.00005
3	0.200	0.00000	0.00020	0.00010	3	0.200	0.00010	-0.00020
4	0.300	0.00015	0.00020	0.00025	4	0.300	0.00010	-0.00035
5	0.400	0.00025	0.00010	0.00035	5	0.400	0.00015	-0.00035
6	0.500	0.00040	0.00020	0.00045	6	0.500	0.00015	-0.00040
7	0.600	0.00055	0.00030	0.00060	7	0.600	0.00015	-0.00045
8	0.700	0.00065	0.00040	0.00070	8	0.700	0.00015	-0.00045
9	0.800	0.00080	0.00060	0.00105	9	0.800	0.00020	-0.00050
10	0.900	0.00095	0.00055	0.00105	10	0.900	0.00020	-0.00055
11	1.000	0.00110	0.00080	0.00130	11	1.000	0.00020	-0.00060
12	1.100	0.00120	0.00090	0.00140	12	1.100	0.00020	-0.00055
13	1.200	0.00140	0.00105	0.00150	13	1.200	0.00020	-0.00060
14	1.300	0.00155	0.00110	0.00155	14	1.300	0.00020	-0.00065
15	1.400	0.00175	0.00120	0.00165	15	1.400	0.00020	-0.00065
16	1.500	0.00185	0.00150	0.00185	16	1.500	0.00020	-0.00065
17	1.600	0.00185	0.00160	0.00195	17	1.600	0.00015	-0.00075
18	1.700	0.00205	0.00175	0.00205	18	1.700	0.00015	-0.00070
19	1.800	0.00210	0.00185	0.00230	19	1.800	0.00015	-0.00075
20	1.900	0.00225	0.00200	0.00245	20	1.900	0.00015	-0.00080
21	2.000	0.00240	0.00205	0.00260	21	2.000	0.00015	-0.00085
22	2.100	0.00250	0.00215	0.00270	22	2.100	0.00015	-0.00085
23	2.200	0.00275	0.00230	0.00280	23	2.200	0.00010	-0.00085
24	2.300	0.00285	0.00240	0.00285	24	2.300	0.00010	-0.00085
25	2.400	0.00290	0.00255	0.00300	25	2.400	0.00005	-0.00090
26	2.500	0.00305	0.00265	0.00305	26	2.500	0.00005	-0.00090
27	2.600	0.00315	0.00275	0.00315	27	2.600	0.00005	-0.00095
28	2.700	0.00325	0.00300	0.00325	28	2.700	0.00005	-0.00100
29	2.800	0.00330	0.00310	0.00335	29	2.800	0.00000	-0.00100
30	2.900	0.00340	0.00320	0.00345	30	2.900	0.00000	-0.00100
31	3.000	0.00350	0.00335	0.00355	31	3.000	0.00000	-0.00105
32	3.100	0.00365	0.00345	0.00360	32	3.100	0.00000	-0.00110
33	3.200	0.00370	0.00350	0.00370	33	3.200	0.00000	-0.00110
34	3.300	0.00375	0.00345	0.00380	34	3.300	-0.00005	-0.00110
35	3.400	0.00380	0.00360	0.00390	35	3.400	-0.00005	-0.00110
36	3.500	0.00390	0.00370	0.00390	36	3.500	-0.00005	-0.00115
37	3.600	0.00405	0.00380	0.00400	37	3.600	-0.00005	-0.00120
38	3.700	0.00405	0.00385	0.00405	38	3.700	-0.00010	-0.00130
39	3.800	0.00410	0.00390	0.00405	39	3.800	-0.00010	-0.00130
40	3.900	0.00415	0.00400	0.00415	40	3.900	-0.00010	-0.00130
41	4.000	0.00420	0.00405	0.00415	41	4.000	-0.00010	-0.00130
42	4.100	0.00415	0.00410	0.00415	42	4.100	-0.00010	-0.00125
43	4.200	0.00420	0.00410	0.00420	43	4.200	-0.00010	-0.00135
44	4.300	0.00425	0.00420	0.00420	44	4.300	-0.00015	-0.00140
45	4.400	0.00425	0.00425	0.00425	45	4.400	-0.00015	-0.00145
46	4.500	0.00430	0.00425	0.00420	46	4.500	-0.00055	-0.00140
47	4.600	0.00430	0.00435	0.00425	47	4.600	-0.00055	-0.00145
48	4.700	0.00430	0.00430	0.00420	48	4.700	-0.00055	-0.00145
49	4.800	0.00430	0.00425	0.00420	49	4.800	-0.00060	-0.00140
50	4.900	0.00430	0.00430	0.00420	50	4.900	-0.00065	-0.00150

51	5.000	0.00425	0.00430	0.00415	51	5.000	-0.00065	-0.00155
52	5.100	0.00425	0.00435	0.00410	52	5.100	-0.00065	-0.00160
53	5.200	0.00425	0.00430	0.00410	53	5.200	-0.00070	-0.00160
54	5.300	0.00425	0.00425	0.00405	54	5.300	-0.00070	-0.00155
55	5.400	0.00425	0.00420	0.00405	55	5.400	-0.00070	-0.00165
56	5.500	0.00415	0.00420	0.00400	56	5.500	-0.00070	-0.00165
57	5.600	0.00415	0.00415	0.00395	57	5.600	-0.00075	-0.00170
58	5.700	0.00420	0.00410	0.00390	58	5.700	-0.00075	-0.00175
59	5.800	0.00415	0.00410	0.00390	59	5.800	-0.00075	-0.00170
60	5.900	0.00415	0.00405	0.00380	60	5.900	-0.00075	-0.00175
61	6.000	0.00405	0.00400	0.00370	61	6.000	-0.00075	-0.00185
62	6.100	0.00410	0.00400	0.00365				
63	6.200	0.00400	0.00390	0.00360				
64	6.300	0.00400	0.00385	0.00355				
65	6.400	0.00390	0.00385	0.00355				
66	6.500	0.00385	0.00375	0.00345				
67	6.600	0.00380	0.00370	0.00335				
68	6.700	0.00370	0.00360	0.00330				
69	6.800	0.00370	0.00355	0.00325				
70	6.900	0.00365	0.00345	0.00315				
71	7.000	0.00360	0.00340	0.00310				
72	7.100	0.00340	0.00330	0.00310				
73	7.200	0.00330	0.00325	0.00300				
74	7.300	0.00325	0.00315	0.00295				
75	7.400	0.00330	0.00310	0.00285				
76	7.500	0.00325	0.00300	0.00275				
77	7.600	0.00315	0.00300	0.00265				
78	7.700	0.00305	0.00290	0.00260				
79	7.800	0.00300	0.00290	0.00255				
80	7.900	0.00290	0.00275	0.00250				
81	8.000	0.00285	0.00270	0.00240				
82	8.100	0.00270	0.00265	0.00240				
83	8.200	0.00270	0.00260	0.00235				
84	8.300	0.00260	0.00260	0.00235				
85	8.400	0.00260	0.00250	0.00245				
86	8.500	0.00250	0.00245	0.00260				
87	8.600	0.00250	0.00245	0.00245				
88	8.700	0.00250	0.00255	0.00170				

Shot # 396 Cap thickness profile Polish



LLNL Big Gun Facility

Impactor Number: 1.5Ta-1

Impactor Number	1.5Ta-1
Impact Material	1.5Ta-1
Average Thickness	1.496 mm
Face Diameter	.953 in.
Large Diameter	.998 in.
Impactor Weight	11.8504 gms.
Wet Weight	11.141 gms.
Water Temp	22.4 °C
Conversion Factor	.99771
Density	16.6666
Part Number	
Projectile Weight	24.9972 gms.
Shot Number	396 (CA TECH)

Flyer

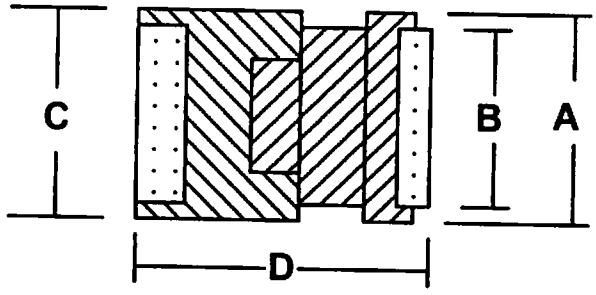
		No. 3	1.497 mm					
No. 7	1.497 mm					No. 6	1.497 mm	
No. 4	1.496 mm		No. 1	1.498 mm		No. 2	1.496 mm	
No. 8	1.495 mm					No. 9	1.495 mm	
		No. 5	1.495 mm					

Sabot

		No. 3	22.943 mm					
No. 7	22.935 mm					No. 6	22.952 mm	
No. 4	22.930 mm		No. 1	22.954 mm		No. 2	22.953 mm	
No. 8	22.930 mm					No. 9	22.948 mm	
		No. 5	22.939 mm					

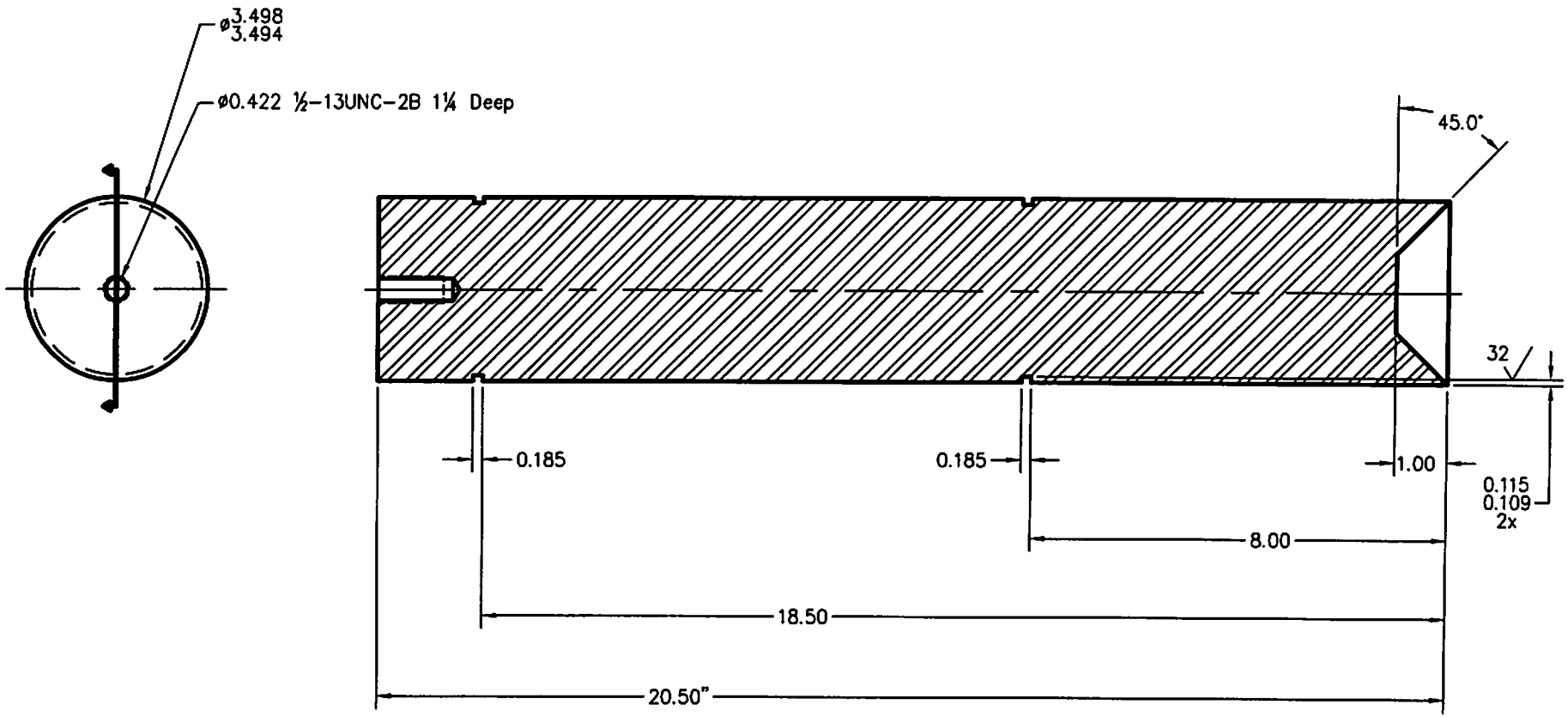
Notes:

1. CUSTOM PROJECTILE FOR
CAL TECH / THEIR SHOT
01 / 06 / 2010
SHOT ON
LBS. PRESSURE
INCH DEPTH
MY EST. LBS. PRES.: 109



A	1.0998	in.
B	1.094	in.
C	1.1119	in.
D	.9036	in.

Impactor Number: 1.5Ta-1



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH 63

DRAWN	DATE
M. Long	10/04/01
ENGINEER	DATE
APPROVED	DATE

MATERIAL: H.D. POLY

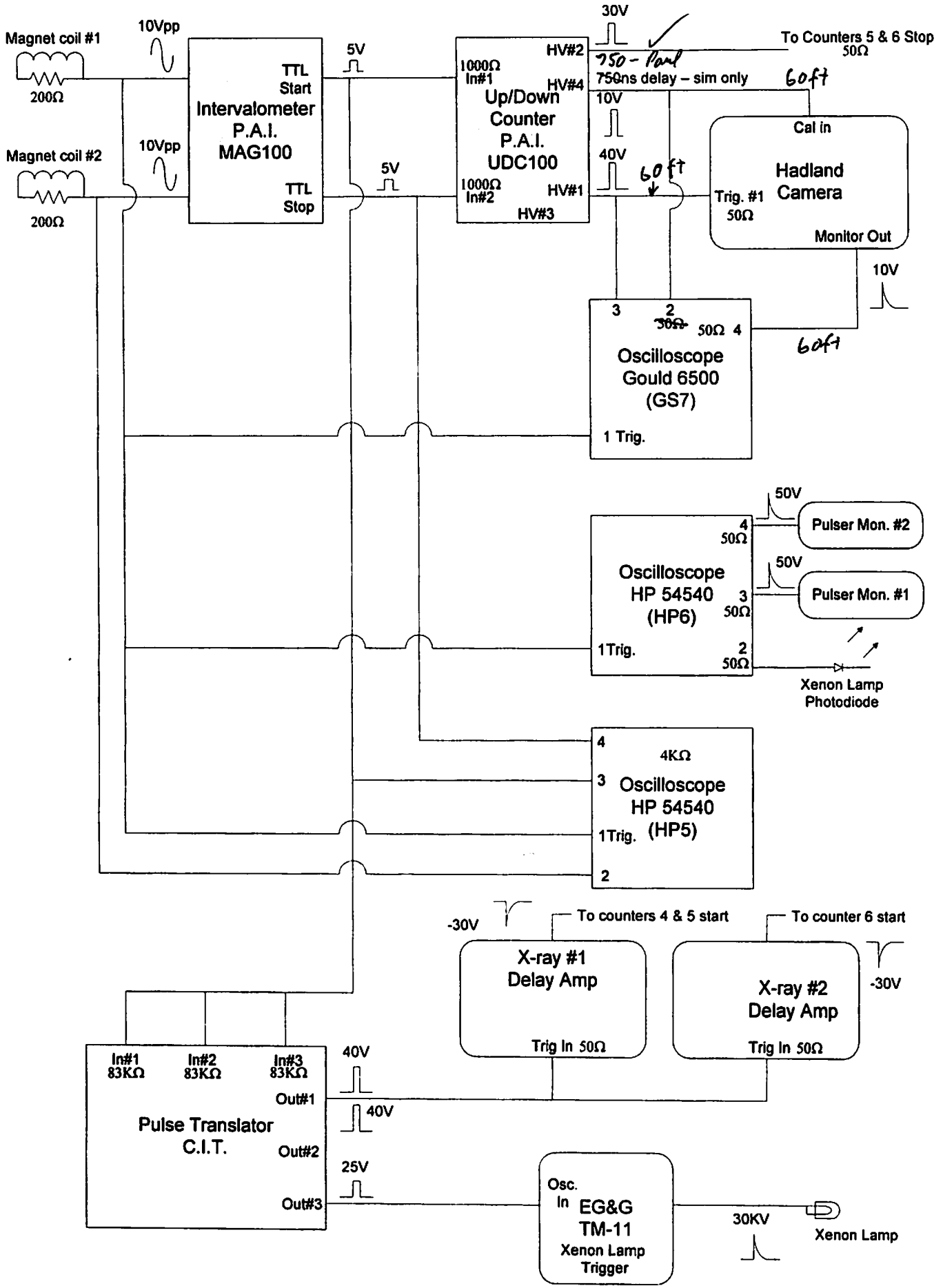
CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: PISTON –1 Piece

SCALE	SHEET		DRAWING NUMBER
1:2	1 of 1	B	LGG–029

396

Shot #~~378~~ Scope Schematic



C. Rm:

centfind → camera cal HV4 (spare)

(not 9.) impact pins

4. camera mon

1. camera trig HV1

Tank

9. target pins HV4 (counter stop)

4. Camera mon

1. Camera trig ~~HV2~~ HV1

revised by Paul 1/27/10

Shot 396 Nominal Timeline Preshot

V	5000				
cable time	90	150		M1-M2 distance	0.203606
intervalometer intrinsic delay	[redacted]			M2-target distance	0.212535
UDC extra count lag	[redacted]			M2-target fudge	[redacted]
pulse translator delay	150			M1-fid1 distance	0.03
X-ray 1 program delay	[redacted]	3100	X-ray 1 actual delay	M1-fid2 distance	0.383145
X-ray 2 program delay	[redacted]	73730	X-ray 2 actual delay	Flyer thickness	0.001496
X-ray 1 pulser delay	600				
X-ray 2 pulser delay	[redacted]			Us(Mo)	8480.00602
Camera intrinsic delay	107			driver thickness	0.00209518
Streak duration	1507			estimated sample+cover time	350
ired dead streak before driver	700				

t (ns)	flyer x (m)	shock front (m)	event
0	0.000748		M1 zero-crossing
150	0.001498		HP5-1, GS7-1, Intervalometer start
2450	0.012998		HP5-3, UDC start, signal to pulse translator
2600	0.013748		pulse translator out, GS7 trig
5700	0.029248		X-ray 1 delay amp out to counters 4, 5
6390	0.032698		X-ray 1 fires
6480	0.033148		X-ray 1 pulse monitor at counter 4b
40721	0.204354		M2 zero-crossing
40871	0.205104		HP5-2, Intervalometer stop
43106	0.216279		HP5-4, UDC stop
76330	0.382398		X-ray 2 delay amp, stop counter 4, start counter 6
77045	0.385973		X-ray 2 fires
77135	0.386423		X-ray 2 pulse monitor at counter 4b
82429	0.41289137		UDC out, GS7-3, stop counters 5 and 6
82519	0.41334137		Trigger at camera
82626	0.41387637		Begin Streak
82716	0.41432637		Camera Monitor on GS7-4
83079	0.416141	0	IMPACT
83326		0.002095183	Driver arrival on streak
83676		0.005063185	Sample cutoff on streak
84133		0.008938547	End Streak

			X-ray velocity	5000
				On film
X-ray 1 flyer vs. fid (mm)			2.698	3.1372093
Counter 3:	40656			
		HP5 2-1		40721
UDC upcount:	40656	HP5 4-3		40656
Counter 4:	70630			
X-ray 2 flyer vs. fid (mm)			2.828	3.28837209
Counter 4b:	70655			
Counter 5:	76729	GS7 3-1		82279
Counter 6:	6099	GS7 4-1		82566
Driver cutoff on streak	700			
Sample cutoff on sreak	1050			

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	~~_____~~ µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	~~_____~~ µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	40.6 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	70.602 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	76.436 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	5.839 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	70.586 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	40.55 µsec
UDC Velocity:			5020.74 M/sec

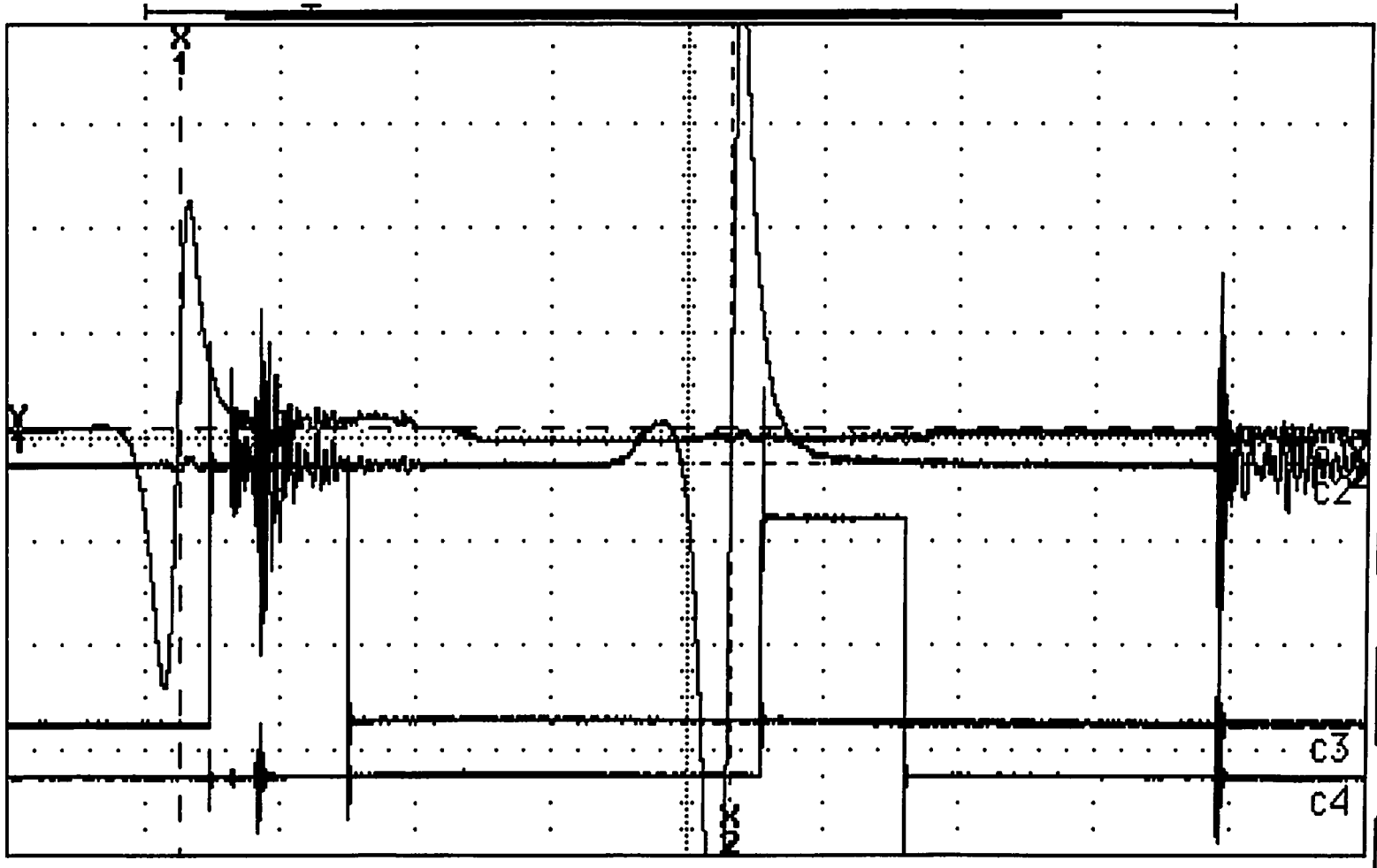
OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 1.7462	Velocity magnet 2 42.3114	40.565 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start 3.8886	2.142 µsec
HP5, ~~2~~ 3-4:	TTL Start ~~Velocity Magnet 2~~	TTL Stop 44.4172	~~40.529~~ µsec 40.529
HP6, 1-2:	Velocity Magnet 1 1.7678	Xenon Lamp Trigger 7.6180	5.850 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	70.581 µsec
GS7, 1-3:	Velocity Magnet 1 7.6152	Camera Trigger (UDC HV 1) 78.196	81.863 µsec
GS7, 1-2:	Velocity Magnet 1	Camera Cal. Sig. (UDC HV 2) 81.863	82.623 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	82.153 µsec

HV4 SIGNAL AT 31/79 mm ON STREAK ≙ 594 ns

Magnet 1 to TTL Start: 2.358 us
Magnet 2 to TTL Stop: 2.324 us
TTL Start to TTL Stop: 40.711 us

Shot 396 HP5

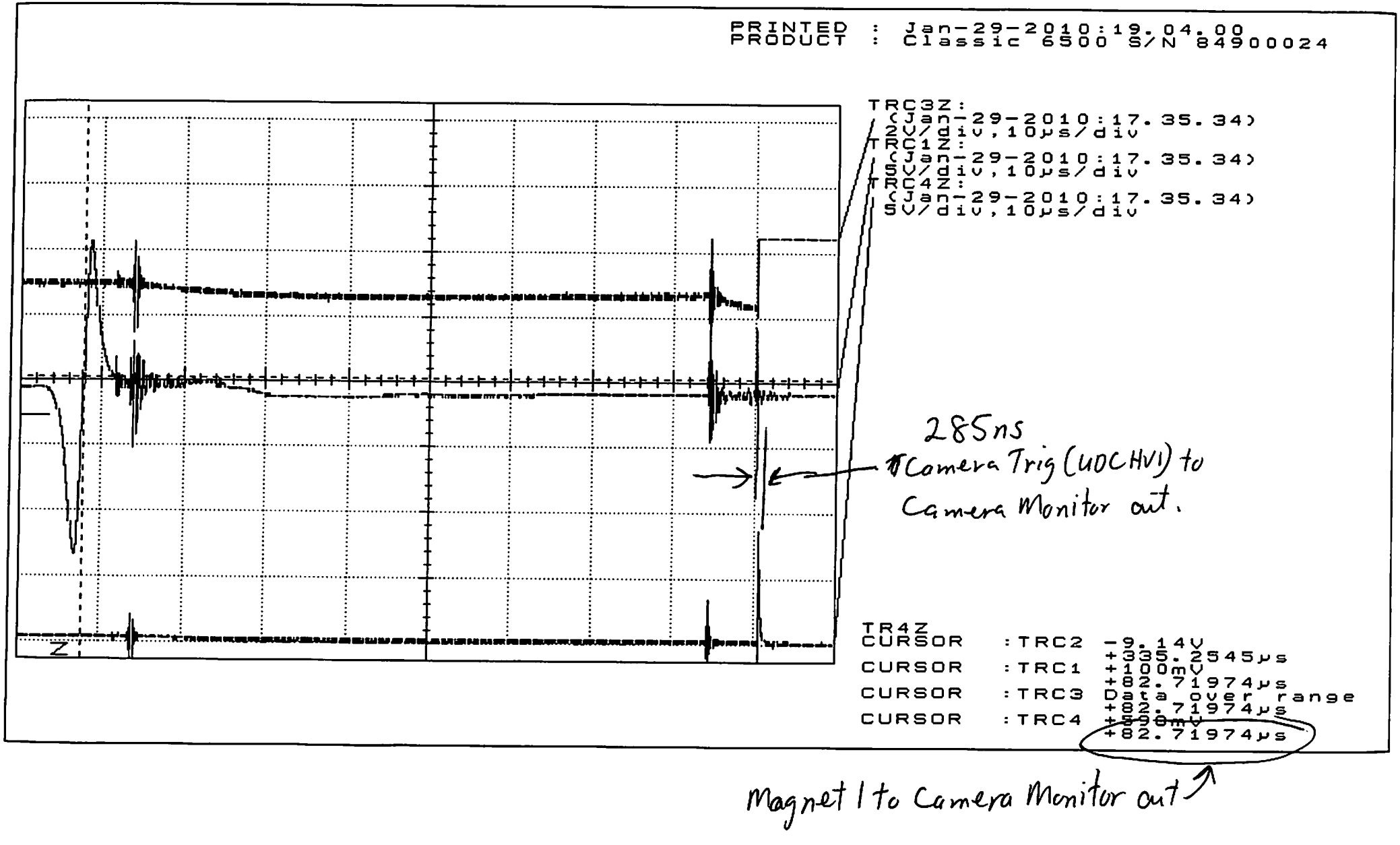


HORIZONTAL
10.0 us/div
200 ns/div
delay
-10.00 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
5 MSa/s
sample clock

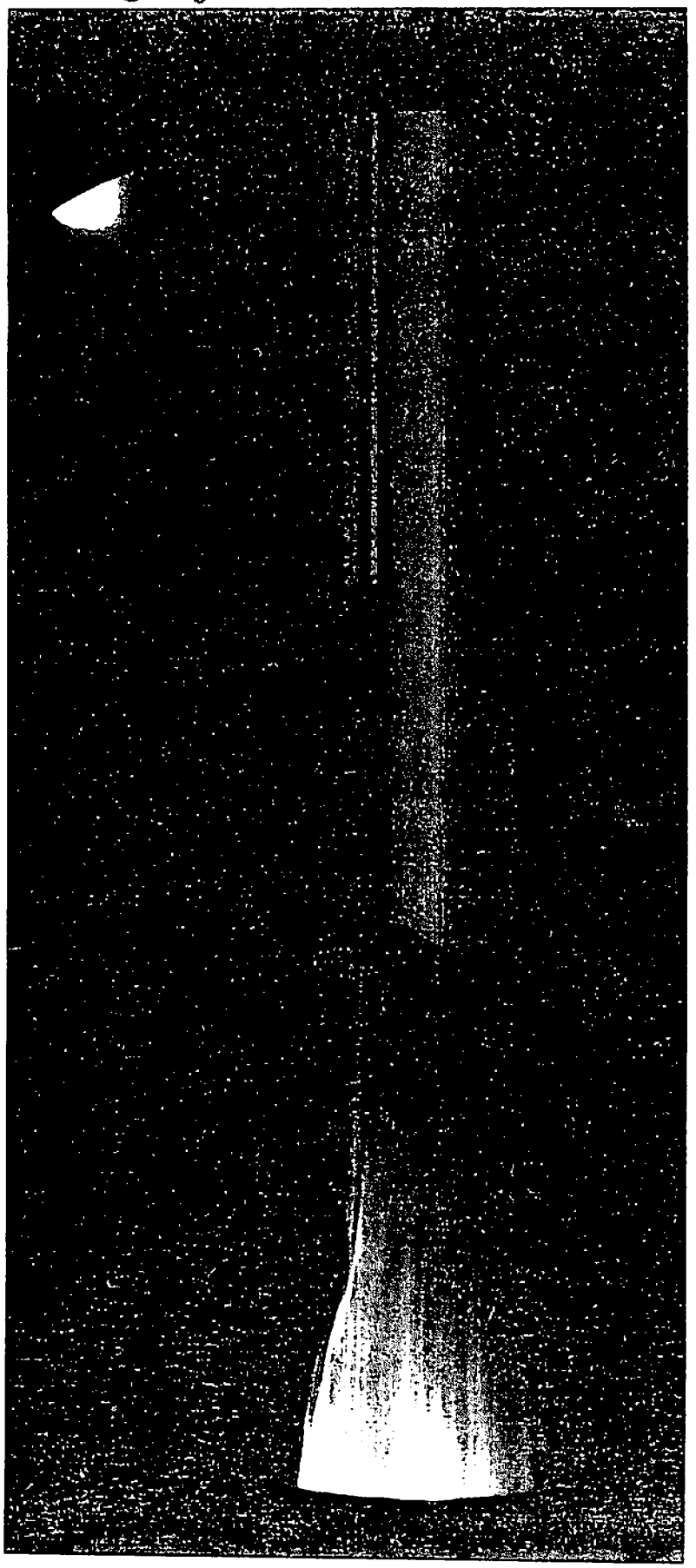
y2(2)	0.00000	V	x2(2)	43.2662	us
y1(1)	0.00000	V	x1(1)	2.52060	us
delta y	0.00000	V	delta x	40.7456	us
			1/delta x	24.5425	kHz

Magnet 1 to 2 interval

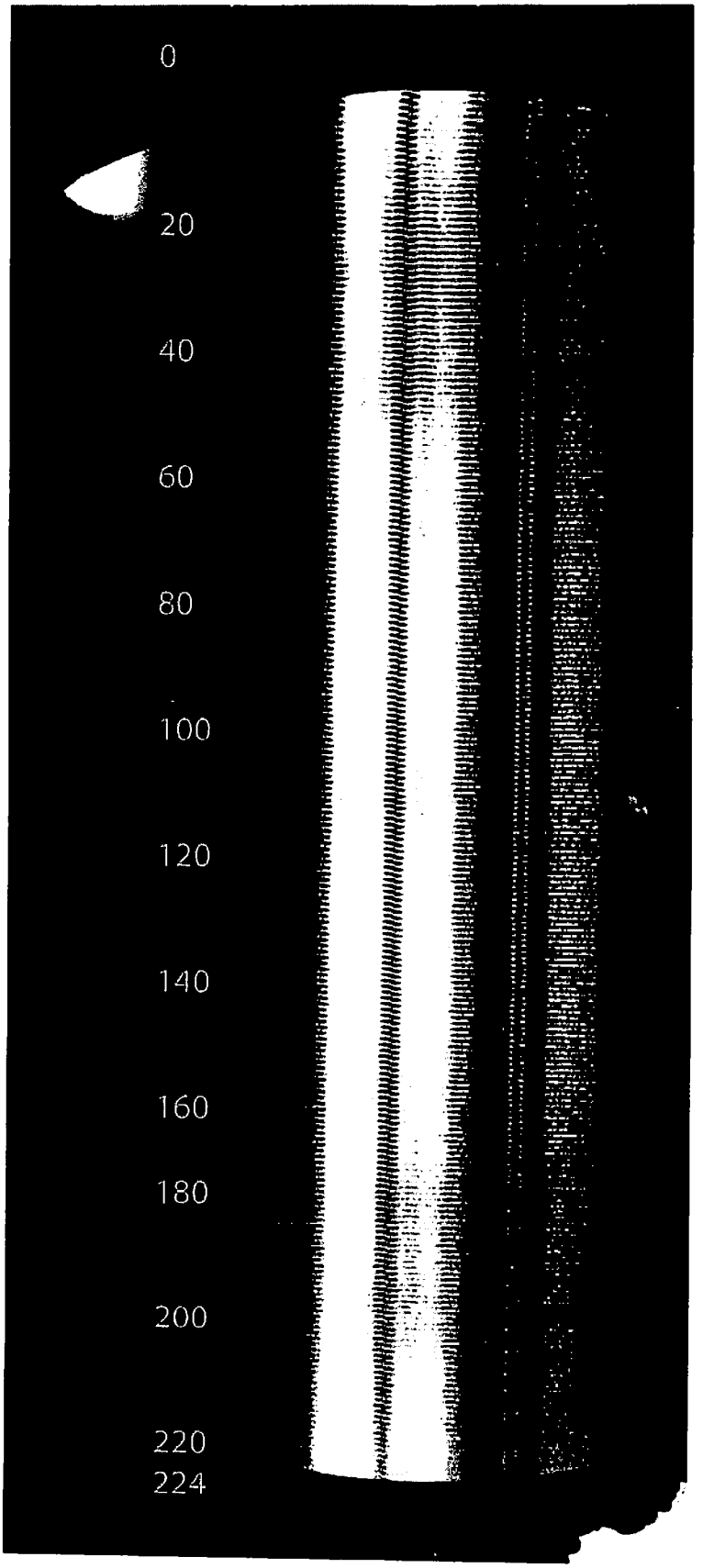
Shot 396 GS7


PRINTED : Jan-29-2010:19.04.00
PRODUCT : Classic 6500 S/N 84900024
TRC3Z:
(Jan-29-2010:17.35.34)
2V/div,10µs/div
TRC1Z:
(Jan-29-2010:17.35.34)
5V/div,10µs/div
TRC4Z:
(Jan-29-2010:17.35.34)
5V/div,10µs/div
285ns
Camera Trig (U0CHV1) to
Camera Monitor out.
TR4Z
CURSOR :TRC2 -9.14V
+335.2545µs
CURSOR :TRC1 +100mV
+82.71974µs
CURSOR :TRC3 Data over range
+82.71974µs
CURSOR :TRC4 +598mV
+82.71974µs
Magnet 1 to Camera Monitor out

396 Shot



396 Cal.



224 × 6.757 ns = 1513 ns

LIGHT GAS GUN DATA SHEET

Shot No. 409 Date 7/1/10

Target:

Sample Material FAYALITE sample 185 Crystallographic orientation —

Source Location UNIV. OF MICHIGAN (Powder) Thickness:1 _____ in.

Type of Measurement HEATING - EOS 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height — in. Driver Plate Thickness _____ in.
(shim to driver) Material _____

4/7/10
Projectile:

Weight 18.0824 gms. Length 0.9020 in. Skirt Diameter 0.9852 in.

Flyer Plate Material Ta Leading Edge Dia. 0.9802 in.

Thickness 0.0604 in. Major Dia. 0.812 in. Depth Inserted 6 in.

Minor Dia. 0.750 in. insertion force: 60 lbs

Barrel Dimensions:

Breech Diameter 0.9848 in. Muzzle Diameter 0.980 in. Taper 0.0048 in.

Ellipticity @ projectile depth insertion point .0007 in.

Piston:

Weight 6.01 lb. Length 20.5 in. O-ring Groove Depth .110 in.

Diameter: Front 3.496 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure −30 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 723 gms. Type IMR 4350 Total Charge 735 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 6.0 km/sec Piston 0.70 km/sec

Notes: 1299°C @ shot time 5:15 min. shot
3.85 KV

L.G.G.

Camera Streak Duration: 1500 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.82

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 1.90 µsec Flash X-ray #2 61.21 µsec

Static Streak Photo 70 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0558 in. min.	0.0916 in. min.
0.0560 in. max.	0.0931 in. max

Expected Burst Pressure 4K psi

Instrument Tank/Vacuum Pump Pressure: 70/50 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.65 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.710 km/sec

Piston Velocity from Gauge #1 to #3: 0.709 km/sec

Projectile Velocity from UDC: 6054.53 m/sec

Projectile Velocity from X-ray: _____ km/sec

6.070

L.G.G.

COUNTER CONNECTIONS

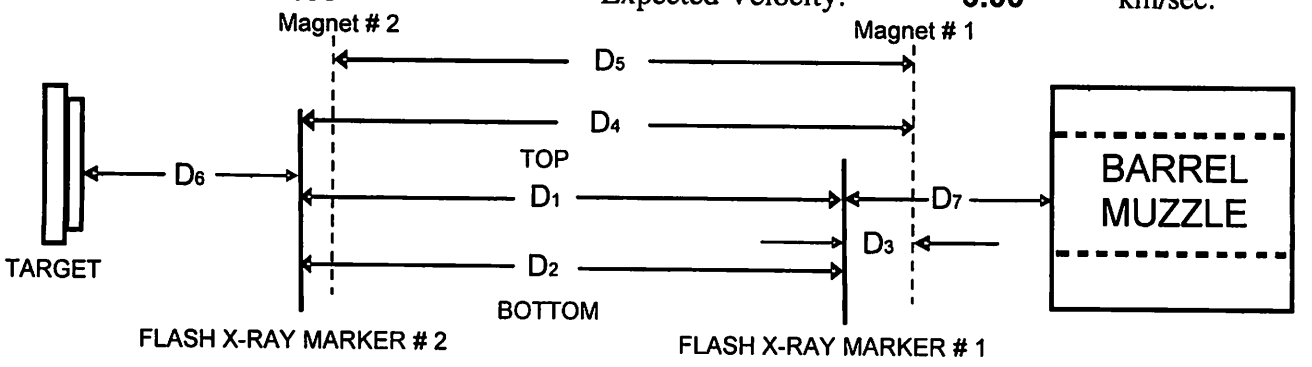
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	429 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	860 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	33.6 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	59.083 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	64.036 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	4.957 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	59.078 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	33.63 µsec
UDC Velocity:			6054.53 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 1.8938	Velocity magnet 2 35.5298	33.636 µsec	
HP5, 1-3:	Velocity Magnet 1	TTL Start 3.9588	2.065 µsec	
HP5, 2-4:	Velocity Magnet 2	TTL Stop 37.5840	2.054 µsec	
HP6, 1-2:	Velocity Magnet 1 1.9008	Xenon Lamp Trigger 6.5016	4.601 µsec	
HP6, 3-4:	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	— µsec	scope ch's 3+4 off
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	68.226 µsec	68.235
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	68.511 µsec	

TARGET MEASUREMENT

Shot No. **409** Expected Velocity: **6.00** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	36.0	99.0
Measure # 2, mm	30.00	383.15	203.66	37.0	99.0
Average, mm	30.00	383.15	203.61	36.5	99.0
Travel time, µsec	**5.00**	**63.86**	**33.93**	**6.08**	**16.50**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **58.87** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

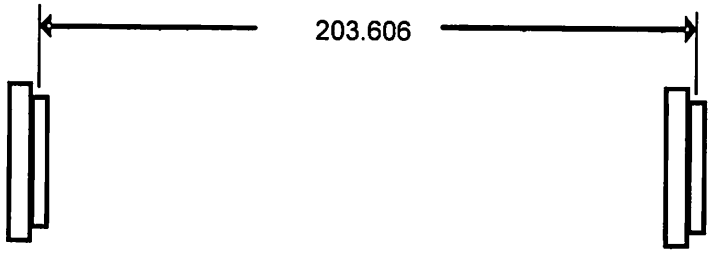
Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **58.85** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **1.90** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **61.21** µsec.

MAGNET DISTANCE

Shot No. **409** Expected Velocity: **6.00**



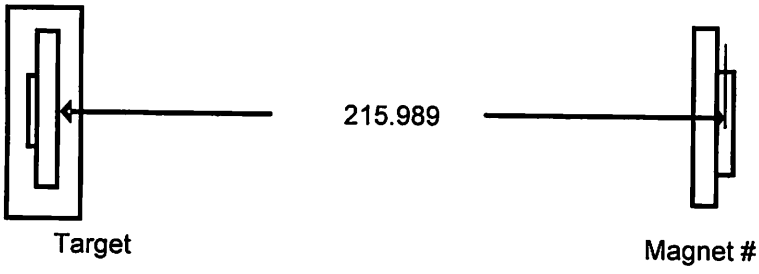
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **33.934 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.376 inch

Second measurement = 8.381 inch

Average measurement = 8.379 inch

Average measurement = 212.814 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

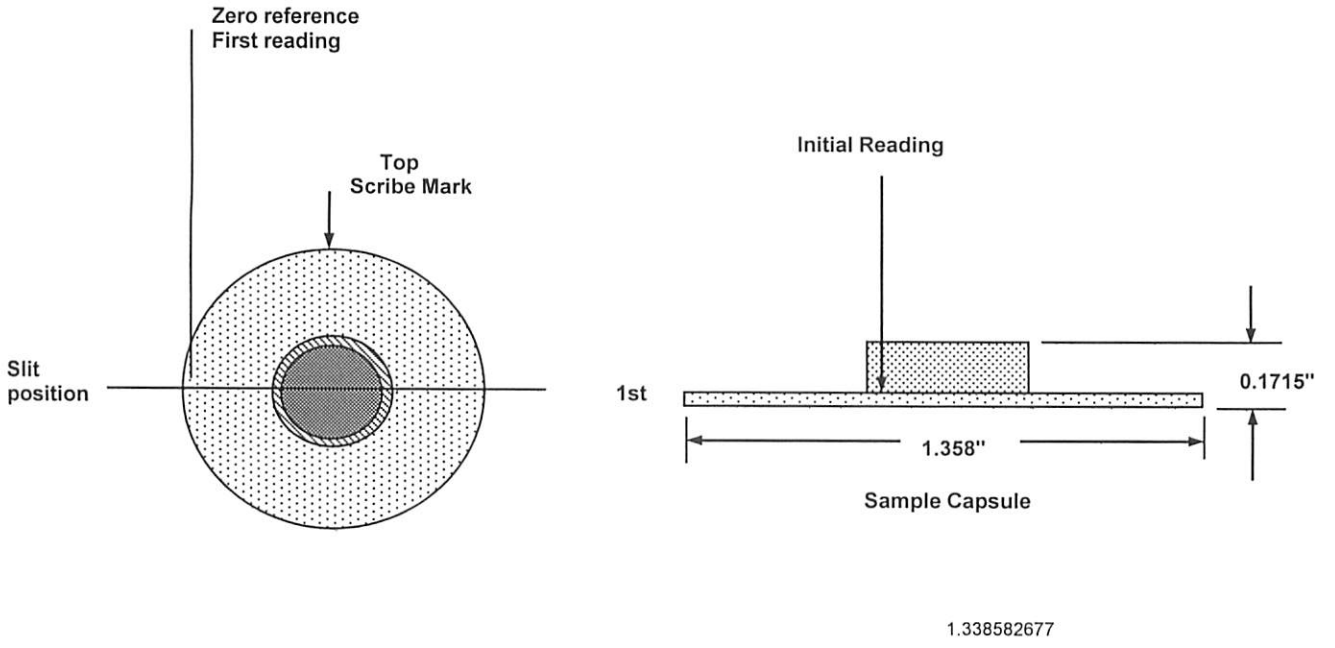
Distance Between Magnet # 2 to Target = 215.989 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **35.998 µsec.**

Fudged Distance between Magnet 2 to Target = ~~0 mm~~ 0.196409 m

SAMPLE CAPSULE: **3 (1-22-10)**
SAMPLE MATERIAL: **Molybdenum**

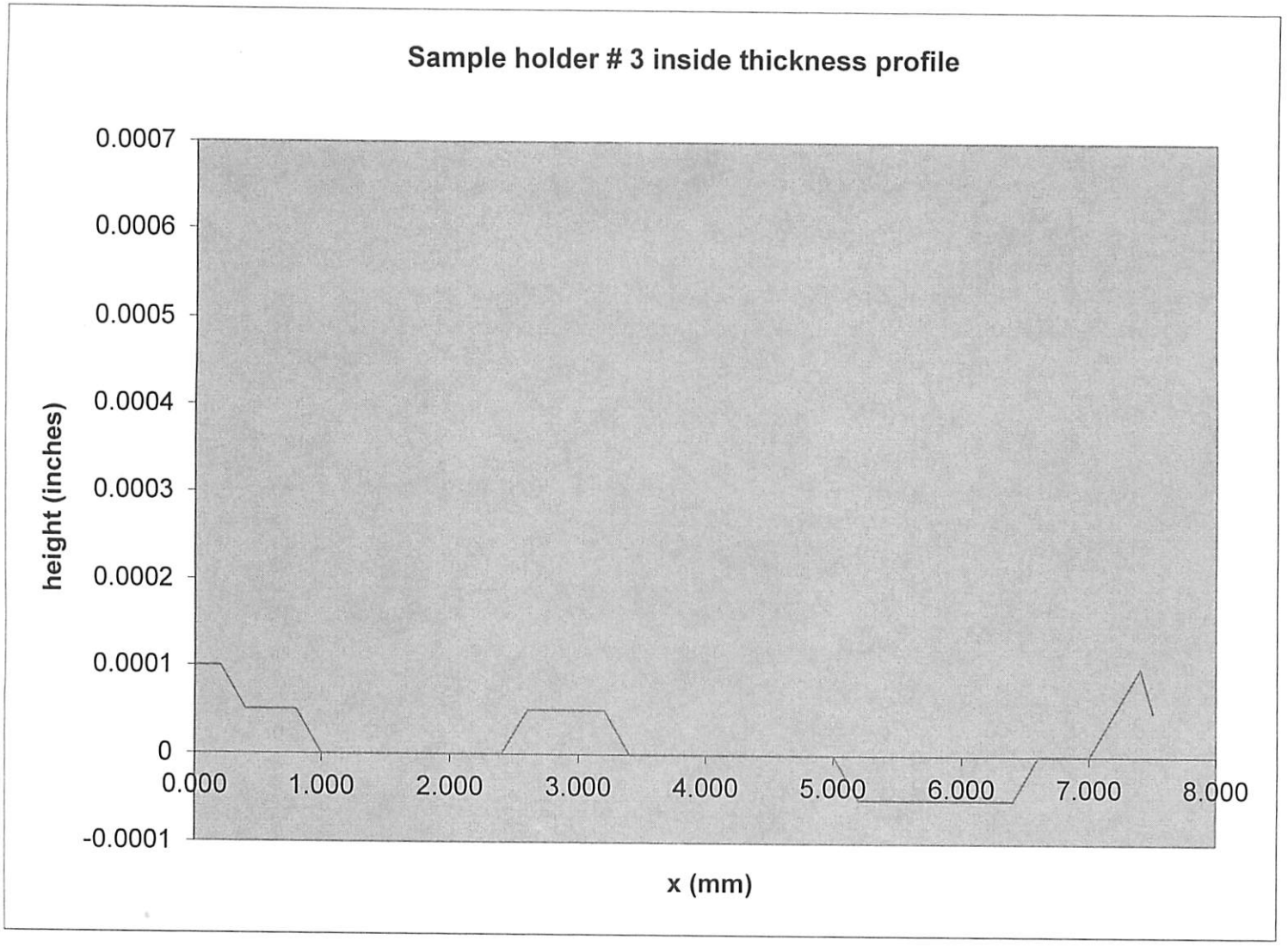
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER # 3



1.338582677

Average thickness reading = 0.00005

Note: The thickness of the reference zero point from the base is = 0.03710 Inches
0.94234 mm


Sample holder # 3 inside thickness profile
height (inches)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
-0.0001
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.0001	3.77	south
2	0.200	0.00010	3.57000	
3	0.400	0.00005	3.37000	
4	0.600	0.00005	3.17000	
5	0.800	0.00005	2.97000	
6	1.000	0.00000	2.77000	
7	1.200	0.00000	2.57000	
8	1.400	0.00000	2.37000	
9	1.600	0.00000	2.17000	
10	1.800	0.00000	1.97000	
11	2.000	0.00000	1.77000	
12	2.200	0.00000	1.57000	
13	2.400	0.00000	1.37000	
14	2.600	0.00005	1.17000	
15	2.800	0.00005	0.97000	
16	3.000	0.00005	0.77000	
17	3.200	0.00005	0.57000	
18	3.400	0.00000	0.37000	
19	3.600	0.00000	0.17000	
20	3.800	0.00000	-0.03000	
21	4.000	0.00000	-0.23000	
22	4.200	0.00000	-0.43000	
23	4.400	0.00000	-0.63000	
24	4.600	0.00000	-0.83000	
25	4.800	0.00000	-1.03000	
26	5.000	0.00000	-1.23000	
27	5.200	-0.00005	-1.43000	
28	5.400	-0.00005	-1.63000	
29	5.600	-0.00005	-1.83000	
30	5.800	-0.00005	-2.03000	
31	6.000	-0.00005	-2.23000	
32	6.200	-0.00005	-2.43000	
33	6.400	-0.00005	-2.63000	
34	6.600	0.00000	-2.83000	
35	6.800	0.00000	-3.03000	
36	7.000	0.00000	-3.23000	
37	7.200	0.00005	-3.43000	
38	7.400	0.00010	-3.63000	
39	7.504	0.00005	-3.73400	north

LGG Shot # 409

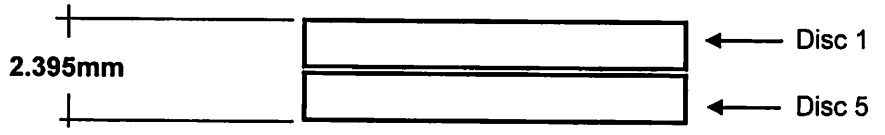
Material: Fayalite **Sample holder** # 3 **Disc:** 1 & 5 **Batch:** H & I

Measurements by: Claire Date: 2/2/2010
Data entry by: Russ O.

Mass Measurements	**Disc # 1**			**Disc # 5**	
A	0.21961	grams	A	0.22123	grams
B	0.21957	grams	B	0.22123	grams
C	0.2957	grams	C	0.2212	grams
Average	0.24496	grams	Average	0.22122	grams

Note: There is no thickness measurement due to the fact that each sample has irregular surfaces

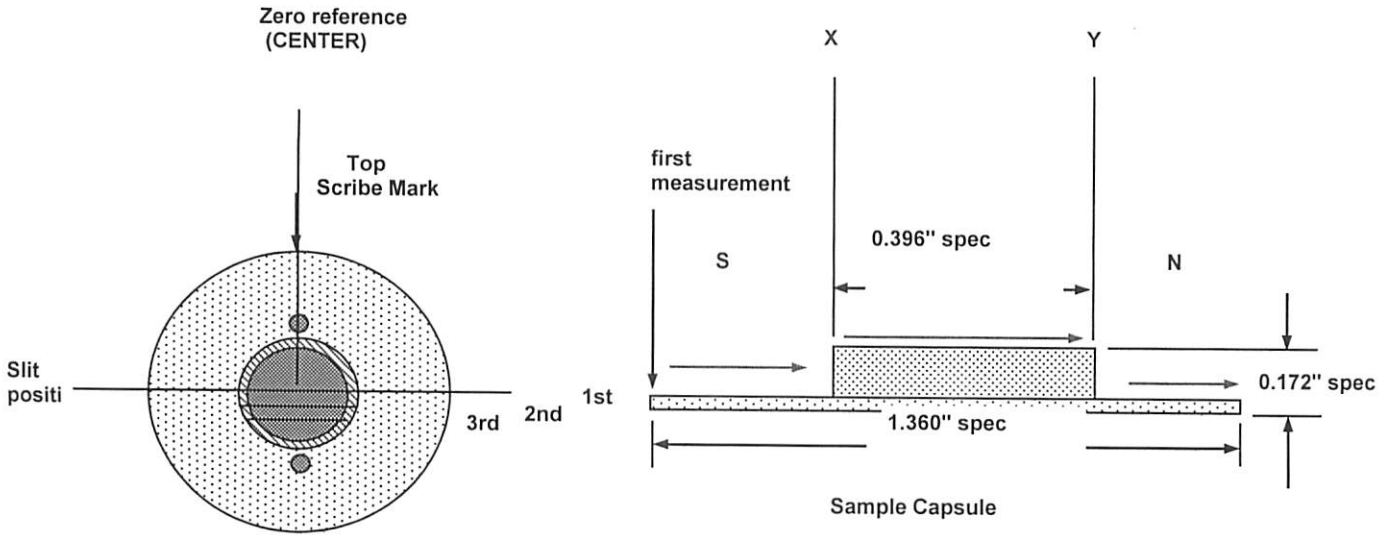
Actual Stacked Height



SHOT No. 409
SAMPLE CAPSULE: 3
SAMPLE MATERIAL: Fayalite

tip used: .7mm long/ flat tip
note: the platform on which the measurement was taken deviates from flat by +0.013 max.
direction of measurement

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = -0.00319

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = -0.00206

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = -0.00363

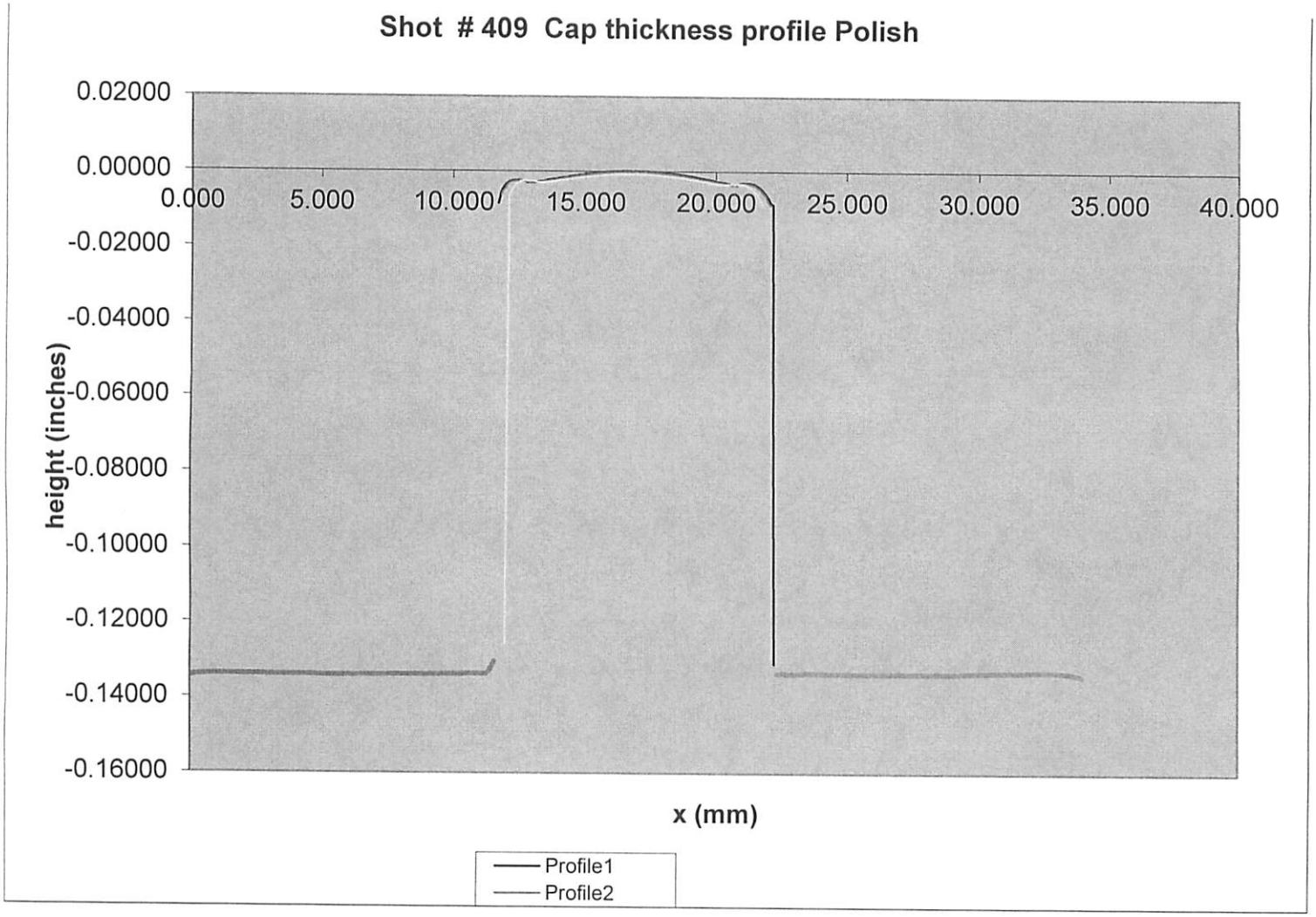
Note: Measurement from reference zero point from the base is = 0.1752 Inches
4.4501 mm

Average thickness of the driver Plate = 0.0415 Inches
1.0534 mm

Thickness of the Carbon Deposited on the coil side is = 85.10 nm

Thickness of the Carbon Deposited on the Projectile side is = 99.00 nm

Distance from the top of the cap to the measured (avg) driver plate 0.13 Inches
3.40 mm


Shot # 409 Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
-0.16000
height (inches)
0.000
5.000
10.000
15.000
20.000
25.000
30.000
35.000
40.000
x (mm)
Profile1
Profile2

1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading	Reading Distance mm
1	0.000	17.000	-0.1346	225	22.400	-5.400	-0.1336	118	11.700
2	0.100	16.900	-0.1345	226	22.500	-5.500	-0.1337	119	11.800
3	0.200	16.800	-0.1343	227	22.600	-5.600	-0.1334	120	11.900
4	0.300	16.700	-0.1343	228	22.700	-5.700	-0.1335	121	12.000
5	0.400	16.600	-0.1342	229	22.800	-5.800	-0.1337	122	12.100
6	0.500	16.500	-0.1342	230	22.900	-5.900	-0.1337	123	12.200
7	0.600	16.400	-0.1341	231	23.000	-6.000	-0.1336	124	12.300
8	0.700	16.300	-0.1341	232	23.100	-6.100	-0.1337	125	12.400
9	0.800	16.200	-0.1341	233	23.200	-6.200	-0.1336	126	12.500
10	0.900	16.100	-0.1340	234	23.300	-6.300	-0.1336	127	12.600
11	1.000	16.000	-0.1340	235	23.400	-6.400	-0.1336	128	12.700
12	1.100	15.900	-0.1340	236	23.500	-6.500	-0.1334	129	12.800
13	1.200	15.800	-0.1340	237	23.600	-6.600	-0.1334	130	12.900
14	1.300	15.700	-0.1340	238	23.700	-6.700	-0.1335	131	13.000
15	1.400	15.600	-0.1340	239	23.800	-6.800	-0.1335	132	13.100
16	1.500	15.500	-0.1340	240	23.900	-6.900	-0.1335	133	13.200
17	1.600	15.400	-0.1340	241	24.000	-7.000	-0.1335	134	13.300
18	1.700	15.300	-0.1341	242	24.100	-7.100	-0.1335	135	13.400
19	1.800	15.200	-0.1341	243	24.200	-7.200	-0.1335	136	13.500
20	1.900	15.100	-0.1340	244	24.300	-7.300	-0.1335	137	13.600
21	2.000	15.000	-0.1341	245	24.400	-7.400	-0.1335	138	13.700
22	2.100	14.900	-0.1341	246	24.500	-7.500	-0.1335	139	13.800
23	2.200	14.800	-0.1341	247	24.600	-7.600	-0.1336	140	13.900
24	2.300	14.700	-0.1341	248	24.700	-7.700	-0.1336	141	14.000
25	2.400	14.600	-0.1341	249	24.800	-7.800	-0.1336	142	14.100
26	2.500	14.500	-0.1341	250	24.900	-7.900	-0.1336	143	14.200
27	2.600	14.400	-0.1341	251	25.000	-8.000	-0.1336	144	14.300
28	2.700	14.300	-0.1341	252	25.100	-8.100	-0.1336	145	14.400
29	2.800	14.200	-0.1341	253	25.200	-8.200	-0.1336	146	14.500
30	2.900	14.100	-0.1341	254	25.300	-8.300	-0.1336	147	14.600
31	3.000	14.000	-0.1341	255	25.400	-8.400	-0.1336	148	14.700
32	3.100	13.900	-0.1341	256	25.500	-8.500	-0.1337	149	14.800
33	3.200	13.800	-0.1341	257	25.600	-8.600	-0.1337	150	14.900
34	3.300	13.700	-0.1341	258	25.700	-8.700	-0.1337	151	15.000
35	3.400	13.600	-0.1341	259	25.800	-8.800	-0.1337	152	15.100
36	3.500	13.500	-0.1341	260	25.900	-8.900	-0.1337	153	15.200
37	3.600	13.400	-0.1342	261	26.000	-9.000	-0.1337	154	15.300
38	3.700	13.300	-0.1342	262	26.100	-9.100	-0.1337	155	15.400
39	3.800	13.200	-0.1341	263	26.200	-9.200	-0.1337	156	15.500
40	3.900	13.100	-0.1342	264	26.300	-9.300	-0.1337	157	15.600
41	4.000	13.000	-0.1342	265	26.400	-9.400	-0.1337	158	15.700
42	4.100	12.900	-0.1342	266	26.500	-9.500	-0.1337	159	15.800
43	4.200	12.800	-0.1342	267	26.600	-9.600	-0.1337	160	15.900
44	4.300	12.700	-0.1342	268	26.700	-9.700	-0.1337	161	16.000
45	4.400	12.600	-0.1342	269	26.800	-9.800	-0.1337	162	16.100
46	4.500	12.500	-0.1342	270	26.900	-9.900	-0.1337	163	16.200
47	4.600	12.400	-0.1342	271	27.000	-10.000	-0.1334	164	16.300
48	4.700	12.300	-0.1342	272	27.100	-10.100	-0.1335	165	16.400
49	4.800	12.200	-0.1342	273	27.200	-10.200	-0.1337	166	16.500
50	4.900	12.100	-0.1342	274	27.300	-10.300	-0.1337	167	16.600
51	5.000	12.000	-0.1342	275	27.400	-10.400	-0.1337	168	16.700
52	5.100	11.900	-0.1342	276	27.500	-10.500	-0.1337	169	16.800

53	5.200	11.800	-0.1342	277	27.600	-10.600	-0.1336	170	16.900
54	5.300	11.700	-0.1342	278	27.700	-10.700	-0.1336	171	17.000
55	5.400	11.600	-0.1342	279	27.800	-10.800	-0.1336	172	17.100
56	5.500	11.500	-0.1342	280	27.900	-10.900	-0.1336	173	17.200
57	5.600	11.400	-0.1342	281	28.000	-11.000	-0.1336	174	17.300
58	5.700	11.300	-0.1342	282	28.100	-11.100	-0.1336	175	17.400
59	5.800	11.200	-0.1342	283	28.200	-11.200	-0.1336	176	17.500
60	5.900	11.100	-0.1342	284	28.300	-11.300	-0.1336	177	17.600
61	6.000	11.000	-0.1342	285	28.400	-11.400	-0.1336	178	17.700
62	6.100	10.900	-0.1342	286	28.500	-11.500	-0.1336	179	17.800
63	6.200	10.800	-0.1342	287	28.600	-11.600	-0.1336	180	17.900
64	6.300	10.700	-0.1342	288	28.700	-11.700	-0.1335	181	18.000
65	6.400	10.600	-0.1342	289	28.800	-11.800	-0.1335	182	18.100
66	6.500	10.500	-0.1342	290	28.900	-11.900	-0.1335	183	18.200
67	6.600	10.400	-0.1342	291	29.000	-12.000	-0.1335	184	18.300
68	6.700	10.300	-0.1342	292	29.100	-12.100	-0.1335	185	18.400
69	6.800	10.200	-0.1342	293	29.200	-12.200	-0.1335	186	18.500
70	6.900	10.100	-0.1342	294	29.300	-12.300	-0.1335	187	18.600
71	7.000	10.000	-0.1342	295	29.400	-12.400	-0.1335	188	18.700
72	7.100	9.900	-0.1341	296	29.500	-12.500	-0.1335	189	18.800
73	7.200	9.800	-0.1342	297	29.600	-12.600	-0.1334	190	18.900
74	7.300	9.700	-0.1341	298	29.700	-12.700	-0.1334	191	19.000
75	7.400	9.600	-0.1341	299	29.800	-12.800	-0.1334	192	19.100
76	7.500	9.500	-0.1341	300	29.900	-12.900	-0.1334	193	19.200
77	7.600	9.400	-0.1341	301	30.000	-13.000	-0.1334	194	19.300
78	7.700	9.300	-0.1341	302	30.100	-13.100	-0.1334	195	19.400
79	7.800	9.200	-0.1341	303	30.200	-13.200	-0.1334	196	19.500
80	7.900	9.100	-0.1341	304	30.300	-13.300	-0.1334	197	19.600
81	8.000	9.000	-0.1341	305	30.400	-13.400	-0.1333	198	19.700
82	8.100	8.900	-0.1341	306	30.500	-13.500	-0.1333	199	19.800
83	8.200	8.800	-0.1341	307	30.600	-13.600	-0.1333	200	19.900
84	8.300	8.700	-0.1341	308	30.700	-13.700	-0.1332	201	20.000
85	8.400	8.600	-0.1341	309	30.800	-13.800	-0.1332	202	20.100
86	8.500	8.500	-0.1340	310	30.900	-13.900	-0.1332	203	20.200
87	8.600	8.400	-0.1340	311	31.000	-14.000	-0.1333	204	20.300
88	8.700	8.300	-0.1340	312	31.100	-14.100	-0.1332	205	20.400
89	8.800	8.200	-0.1340	313	31.200	-14.200	-0.1332	206	20.500
90	8.900	8.100	-0.1340	314	31.300	-14.300	-0.1332	207	20.600
91	9.000	8.000	-0.1340	315	31.400	-14.400	-0.1332	208	20.700
92	9.100	7.900	-0.1340	316	31.500	-14.500	-0.1332	209	20.800
93	9.200	7.800	-0.1339	317	31.600	-14.600	-0.1332	210	20.900
94	9.300	7.700	-0.1340	318	31.700	-14.700	-0.1332	211	21.000
95	9.400	7.600	-0.1339	319	31.800	-14.800	-0.1331	212	21.100
96	9.500	7.500	-0.1340	320	31.900	-14.900	-0.1331	213	21.200
97	9.600	7.400	-0.1339	321	32.000	-15.000	-0.1331	214	21.300
98	9.700	7.300	-0.1339	322	32.100	-15.100	-0.1331	215	21.400
99	9.800	7.200	-0.1339	323	32.200	-15.200	-0.1331	216	21.500
100	9.900	7.100	-0.1339	324	32.300	-15.300	-0.1331	217	21.600
101	10.000	7.000	-0.1339	325	32.400	-15.400	-0.1331	218	21.700
102	10.100	6.900	-0.1339	326	32.500	-15.500	-0.1330	219	21.800
103	10.200	6.800	-0.1339	327	32.600	-15.600	-0.1331	220	21.900
104	10.300	6.700	-0.1339	328	32.700	-15.700	-0.1331	221	22.000
105	10.400	6.600	-0.1339	329	32.800	-15.800	-0.1331	222	22.100
106	10.500	6.500	-0.1339	330	32.900	-15.900	-0.1331	223	22.200
107	10.600	6.400	-0.1339	331	33.000	-16.000	-0.1331	224	22.300
108	10.700	6.300	-0.1338	332	33.100	-16.100	-0.1331		
109	10.800	6.200	-0.1338	333	33.200	-16.200	-0.1332		
110	10.900	6.100	-0.1338	334	33.300	-16.300	-0.1332		
111	11.000	6.000	-0.1338	335	33.400	-16.400	-0.1333		
112	11.100	5.900	-0.1338	336	33.500	-16.500	-0.1334		

113	11.200	5.800	-0.1338	337	33.600	-16.600	-0.1335
114	11.300	5.700	-0.1338	338	33.700	-16.700	-0.1336
115	11.400	5.600	-0.1331	339	33.800	-16.800	-0.1337
116	11.500	5.500	-0.1320	340	33.900	-16.900	-0.1339
117	11.600	5.400	-0.1305	341	34.000	-17.000	-0.1342

	1st	2nd	3 rd
abs dist.	Run	Run	Run
	Reading	Reading	Reading
mm	Inches	Inches	Inches
5.300	-0.00855		
5.200	-0.00570	-0.00630	
5.100	-0.00430	-0.00510	
5.000	-0.00335	-0.00410	-0.12575
4.900	-0.00285	-0.00325	-0.00660
4.800	-0.00260	-0.00285	-0.00505
4.700	-0.00250	-0.00265	-0.00415
4.600	-0.00250	-0.00265	-0.00335
4.500	-0.00250	-0.00260	-0.00290
4.400	-0.00260	-0.00265	-0.00260
4.300	-0.00270	-0.00275	-0.00250
4.200	-0.00310	-0.00295	-0.00255
4.100	-0.00310	-0.00315	-0.00255
4.000	-0.00305	-0.00310	-0.00265
3.900	-0.00295	-0.00305	-0.00280
3.800	-0.00285	-0.00295	-0.00305
3.700	-0.00280	-0.00285	-0.00310
3.600	-0.00270	-0.00275	-0.00310
3.500	-0.00250	-0.00260	-0.00300
3.400	-0.00235	-0.00250	-0.00290
3.300	-0.00220	-0.00235	-0.00285
3.200	-0.00210	-0.00225	-0.00275
3.100	-0.00200	-0.00210	-0.00265
3.000	-0.00190	-0.00200	-0.00250
2.900	-0.00175	-0.00185	-0.00240
2.800	-0.00165	-0.00175	-0.00230
2.700	-0.00155	-0.00165	-0.00220
2.600	-0.00140	-0.00155	-0.00210
2.500	-0.00130	-0.00145	-0.00200
2.400	-0.00120	-0.00130	-0.00190
2.300	-0.00105	-0.00120	-0.00185
2.200	-0.00100	-0.00115	-0.00170
2.100	-0.00090	-0.00100	-0.00165
2.000	-0.00080	-0.00095	-0.00155
1.900	-0.00070	-0.00085	-0.00150
1.800	-0.00060	-0.00075	-0.00140
1.700	-0.00055	-0.00070	-0.00135
1.600	-0.00045	-0.00060	-0.00130
1.500	-0.00040	-0.00055	-0.00120
1.400	-0.00035	-0.00045	-0.00110
1.300	-0.00030	-0.00040	-0.00105
1.200	-0.00020	-0.00035	-0.00100
1.100	-0.00020	-0.00030	-0.00100
1.000	-0.00010	-0.00025	-0.00095
0.900	-0.00005	-0.00020	-0.00095
0.800	-0.00005	-0.00020	-0.00090
0.700	0.00000	-0.00015	-0.00085
0.600	0.00005	-0.00015	-0.00085
0.500	0.00005	-0.00010	-0.00085
0.400	0.00005	-0.00010	-0.00085
0.300	0.00005	-0.00010	-0.00085
0.200 7	0.00000	-0.00010	-0.00085

	oops	
-0.1-y)	-1.0mm (-y)	-2.0 mm(-y)
-0.00895		
-0.0063	-0.00630	
-0.00465	-0.00510	
-0.0036	-0.00410	-0.12575
-0.00305	-0.00325	-0.00660
-0.00275	-0.00285	-0.00505
-0.0026	-0.00265	-0.00415
-0.0026	-0.00265	-0.00335
-0.0026	-0.00260	-0.00290
-0.0027	-0.00265	-0.00260
-0.00285	-0.00275	-0.00250
-0.00305	-0.00295	-0.00255
-0.0032	-0.00315	-0.00255
-0.00315	-0.00310	-0.00265
-0.0031	-0.00305	-0.00280
-0.00295	-0.00295	-0.00305
-0.0029	-0.00285	-0.00310
-0.00275	-0.00275	-0.00310
-0.00265	-0.00260	-0.00300
-0.0025	-0.00250	-0.00290
-0.00235	-0.00235	-0.00285
-0.0022	-0.00225	-0.00275
-0.0021	-0.00210	-0.00265
-0.002	-0.00200	-0.00250
-0.0019	-0.00185	-0.00240
-0.00175	-0.00175	-0.00230
-0.00165	-0.00165	-0.00220
-0.00155	-0.00155	-0.00210
-0.00145	-0.00145	-0.00200
-0.0013	-0.00130	-0.00190
-0.0012	-0.00120	-0.00185
-0.0011	-0.00115	-0.00170
-0.001	-0.00100	-0.00165
-0.0009	-0.00095	-0.00155
-0.0008	-0.00085	-0.00150
-0.00075	-0.00075	-0.00140
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-0.00035	-0.00040	-0.00105
-0.00035	-0.00035	-0.00100
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-0.0001	-0.00015	-0.00085
-0.00005	-0.00010	-0.00085
-0.00005	-0.00010	-0.00085
-0.00005	-0.00010	-0.00085
-0.00005	-0.00010	-0.00085

0.100	0.00005	-0.00010	-0.00085
0.000	0.00000	-0.00015	-0.00085
-0.100	0.00000	-0.00020	-0.00085
-0.200	-0.00005	-0.00020	-0.00090
-0.300	-0.00005	-0.00020	-0.00095
-0.400	-0.00010	-0.00030	-0.00095
-0.500	-0.00015	-0.00030	-0.00100
-0.600	-0.00020	-0.00035	-0.00100
-0.700	-0.00020	-0.00040	-0.00110
-0.800	-0.00030	-0.00045	-0.00115
-0.900	-0.00030	-0.00055	-0.00120
-1.000	-0.00035	-0.00060	-0.00125
-1.100	-0.00045	-0.00070	-0.00135
-1.200	-0.00050	-0.00075	-0.00140
-1.300	-0.00060	-0.00080	-0.00150
-1.400	-0.00065	-0.00095	-0.00155
-1.500	-0.00075	-0.00100	-0.00165
-1.600	-0.00085	-0.00105	-0.00170
-1.700	-0.00095	-0.00120	-0.00175
-1.800	-0.00105	-0.00130	-0.00185
-1.900	-0.00115	-0.00145	-0.00205
-2.000	-0.00130	-0.00155	-0.00215
-2.100	-0.00130	-0.00165	-0.00220
-2.200	-0.00150	-0.00175	-0.00235
-2.300	-0.00165	-0.00185	-0.00245
-2.400	-0.00175	-0.00200	-0.00260
-2.500	-0.00185	-0.00215	-0.00270
-2.600	-0.00200	-0.00220	-0.00280
-2.700	-0.00210	-0.00235	-0.00295
-2.800	-0.00225	-0.00250	-0.00305
-2.900	-0.00240	-0.00265	-0.00315
-3.000	-0.00260	-0.00275	-0.00325
-3.100	-0.00270	-0.00290	-0.00335
-3.200	-0.00285	-0.00305	-0.00340
-3.300	-0.00300	-0.00315	-0.00345
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-3.900	-0.00325	-0.00320	-0.00335
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-4.900	-0.00595	-0.00645	
-5.000	-0.00690	-0.00810	
-5.100	-0.00825	-0.00905	
-5.200	-0.00875		
-5.300	-0.13110		0.00000

off the cap

0.00000	-0.00010	-0.00085
-0.00005	-0.00015	-0.00085
-0.00010	-0.00020	-0.00085
-0.00010	-0.00020	-0.00090
-0.00015	-0.00020	-0.00095
-0.00015	-0.00030	-0.00095
-0.00020	-0.00030	-0.00100
-0.00020	-0.00035	-0.00100
-0.00030	-0.00040	-0.00110
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-0.00035	-0.00055	-0.00120
-0.00050	-0.00060	-0.00125
-0.00055	-0.00070	-0.00135
-0.00065	-0.00075	-0.00140
-0.00075	-0.00080	-0.00150
-0.00075	-0.00095	-0.00155
-0.00090	-0.00100	-0.00165
-0.00100	-0.00105	-0.00170
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-0.00120	-0.00130	-0.00185
-0.00130	-0.00145	-0.00205
-0.00140	-0.00155	-0.00215
-0.00155	-0.00165	-0.00220
-0.00165	-0.00175	-0.00235
-0.00175	-0.00185	-0.00245
-0.00185	-0.00200	-0.00260
-0.00200	-0.00215	-0.00270
-0.00210	-0.00220	-0.00280
-0.00225	-0.00235	-0.00295
-0.00240	-0.00250	-0.00305
-0.00255	-0.00265	-0.00315
-0.00270	-0.00275	-0.00325
-0.00285	-0.00290	-0.00335
-0.00295	-0.00305	-0.00340
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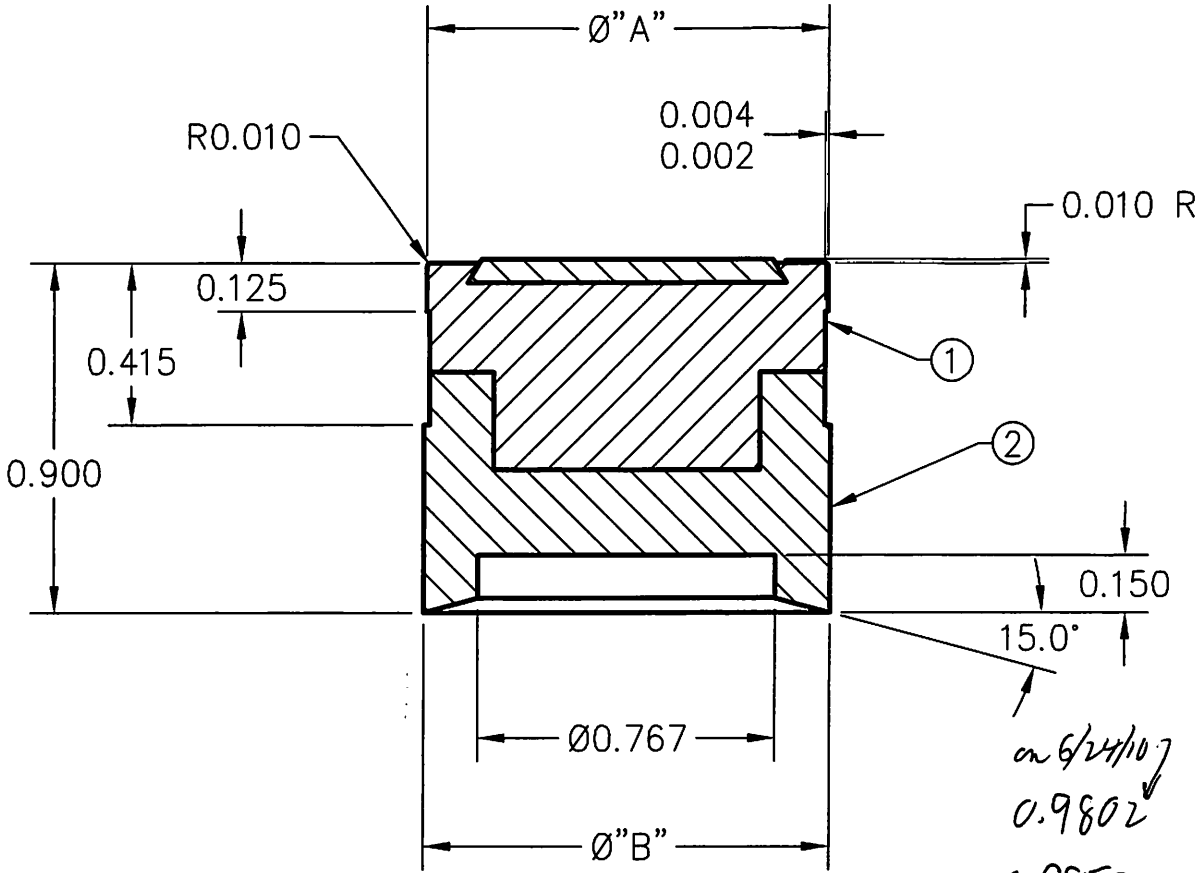
-0.00335	-0.00335	-0.00335
-0.00350	-0.00345	-0.00325
-0.00355	-0.00350	-0.00330
-0.00365	-0.00335	-0.00330
-0.00335	-0.00320	-0.00335
-0.00325	-0.00320	-0.00340
-0.00315	-0.00320	-0.00355
-0.0032	-0.00325	-0.00380
-0.00325	-0.00330	-0.00425
-0.00335	-0.00350	-0.00470
-0.00355	-0.00375	-0.00555
-0.004	-0.00430	-0.00630
-0.00445	-0.00490	-0.00760
-0.0052	-0.00555	-0.00890
-0.00615	-0.00645	
-0.0072	-0.00810	
-0.0089	-0.00905	
-0.00275		



Ta 0.0604 4/7/10

yes ↓ 409

SHOT# ~~408~~ ~~407~~		
A	0.9800	+.0000 −.0005
B	0.9840	+.0005 −.0000

on 6/24/10 ↓ as built:

0.9802 0.9796

0.9852 0.9847

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−048	1
1	Sabot & Flyer Plate	LGG−049	1

Note: Super Glue & Press Fit 1 & 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

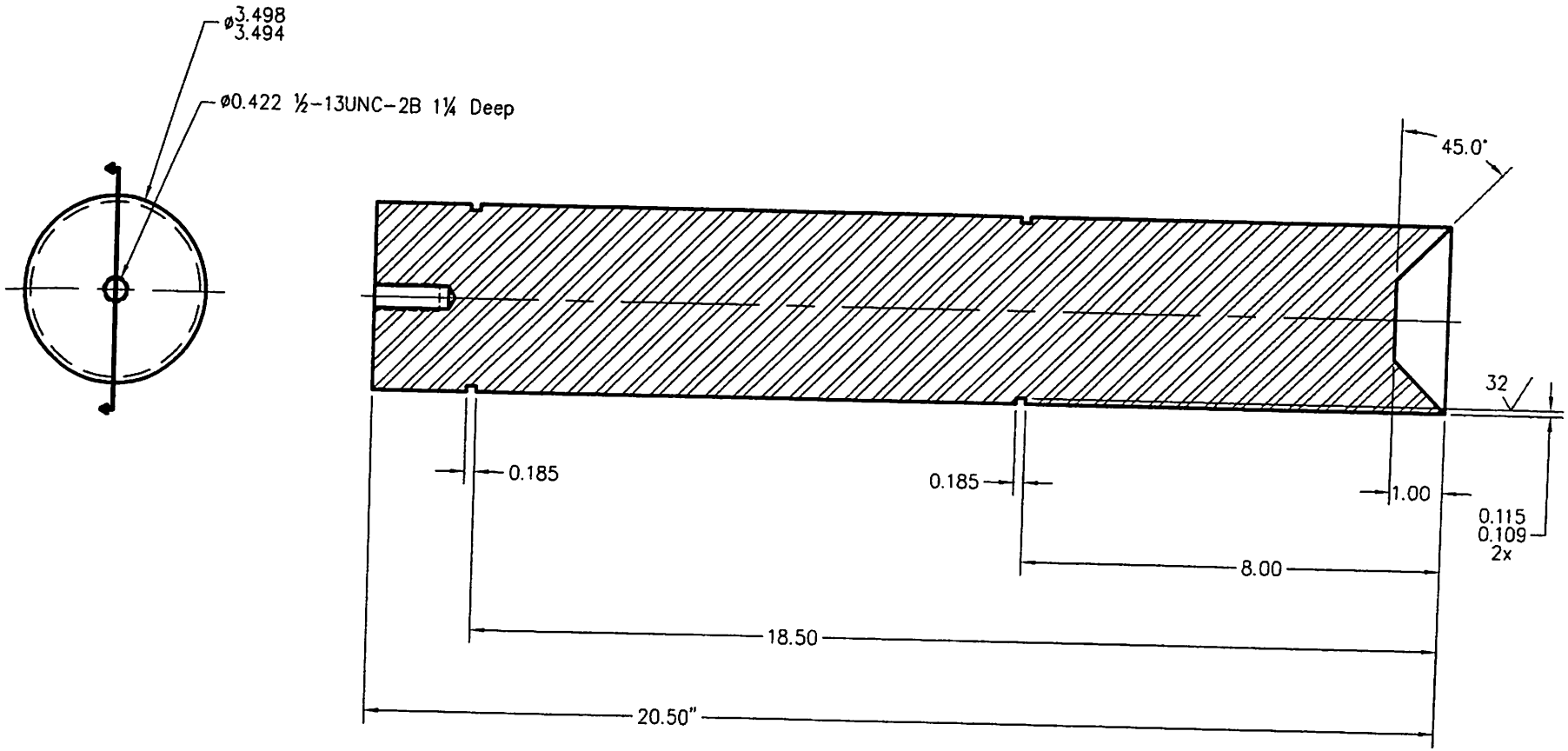
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long DATE 1/23/04
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE
Projectile Assy.

FINISH 16
MATERIAL Zelux−M&HDP
SCALE 2:1
SHEET 2 of 2
A
DRAWING NUMBER LGG−050



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS
FINISH 63

DRAWN	M. Long	DATE 10/04/01
ENGINEER		DATE
APPROVED		DATE
MATERIAL	H.D. POLY	

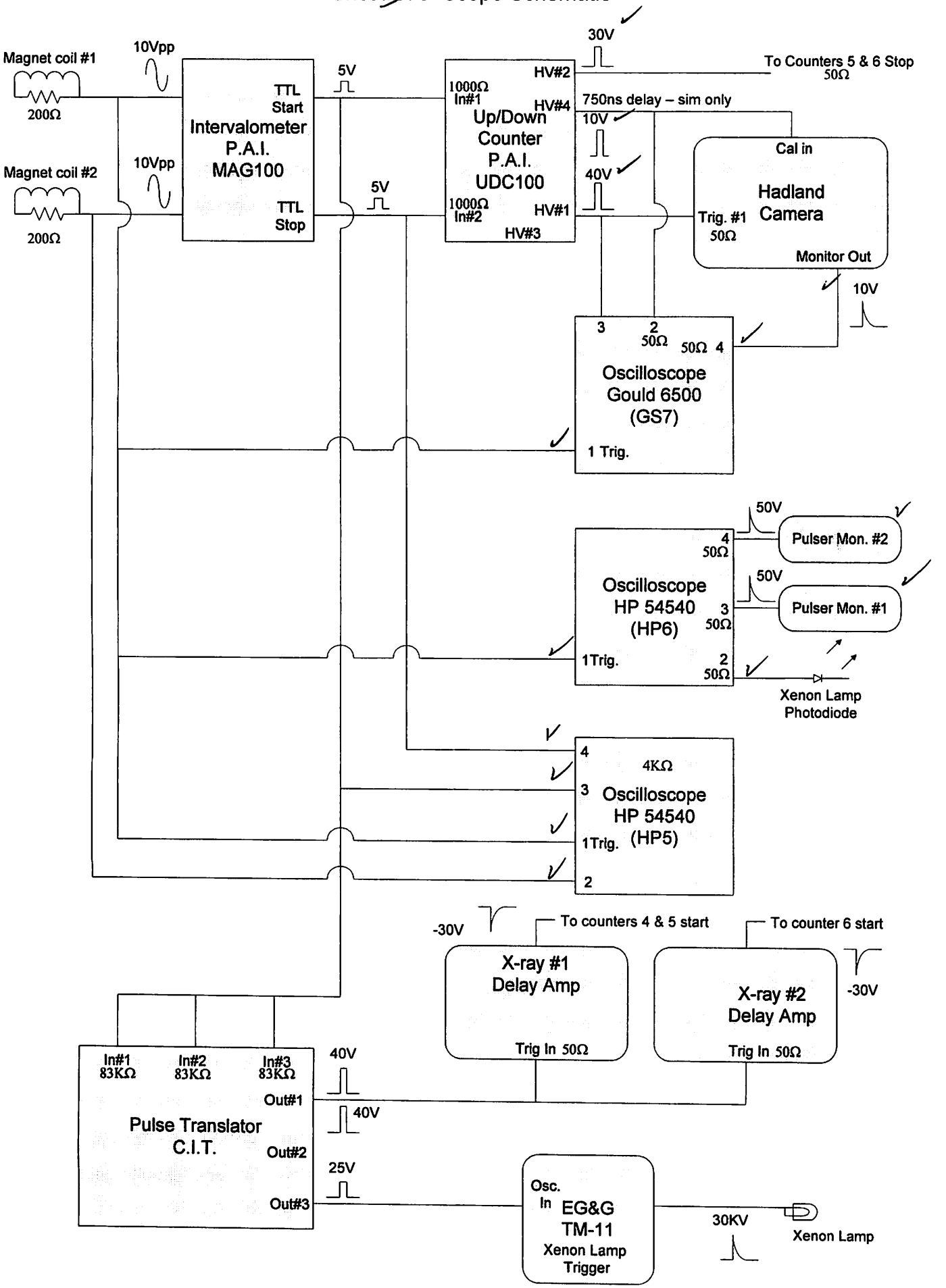
CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: PISTON -1 Piece

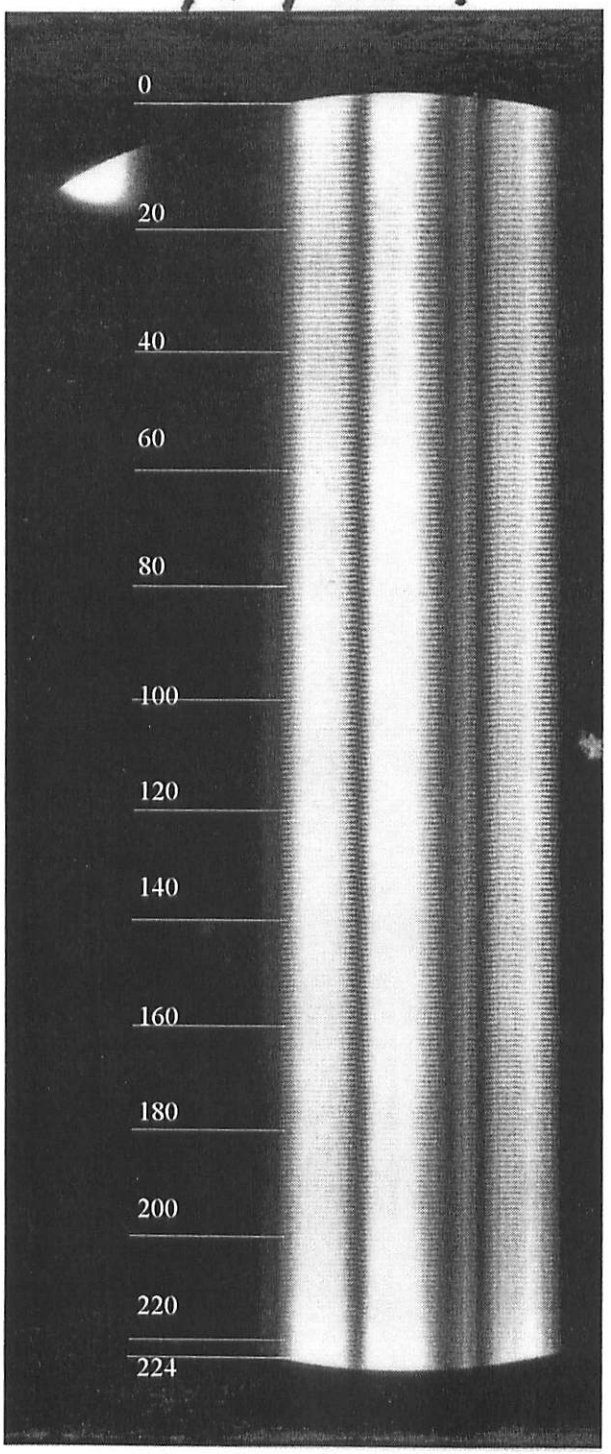
SCALE	SHEET		DRAWING NUMBER
1:2	1 of 1	B	LGG-029

396 + 409

Shot #~~378~~ Scope Schematic

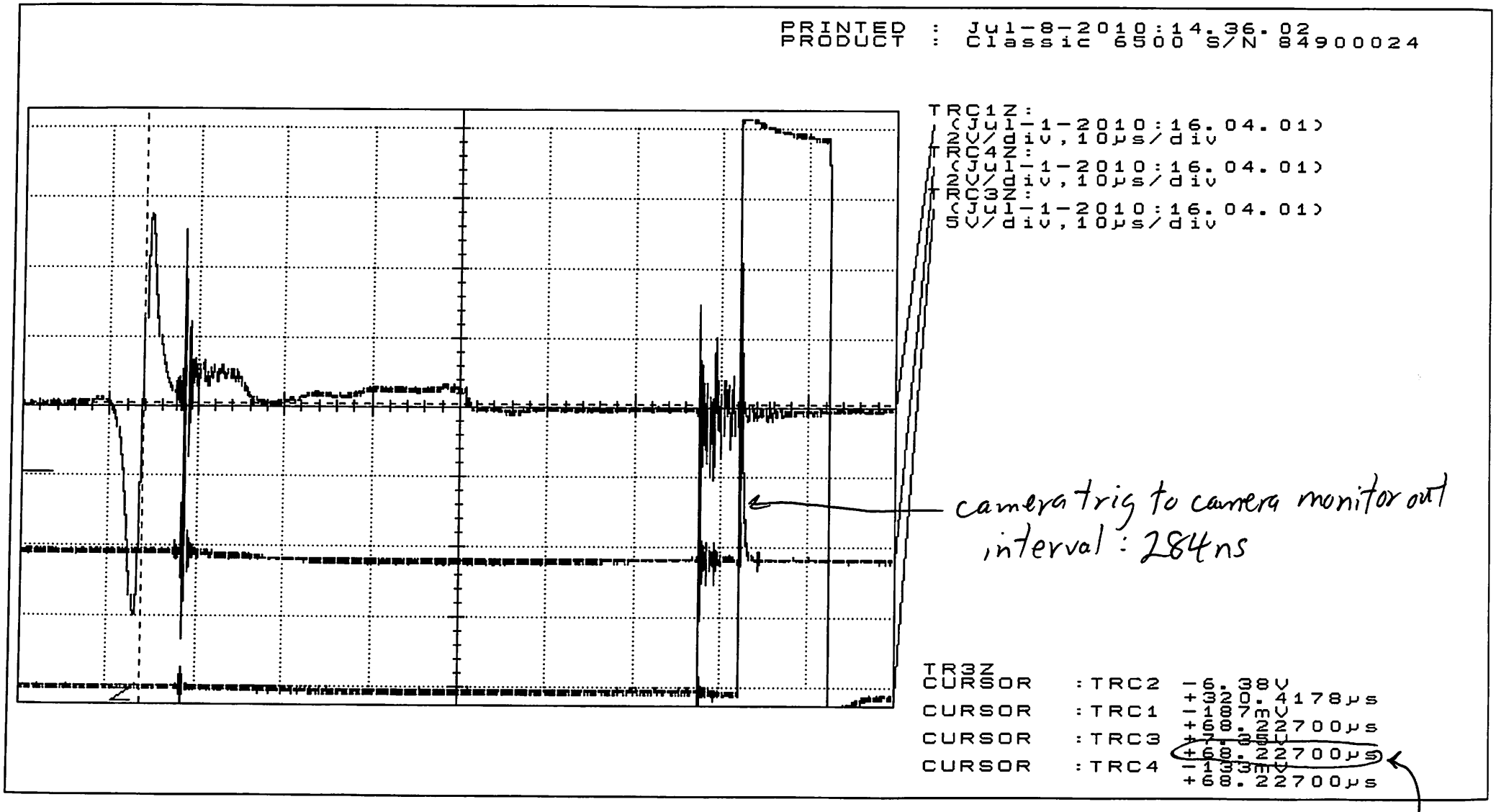


409Cal

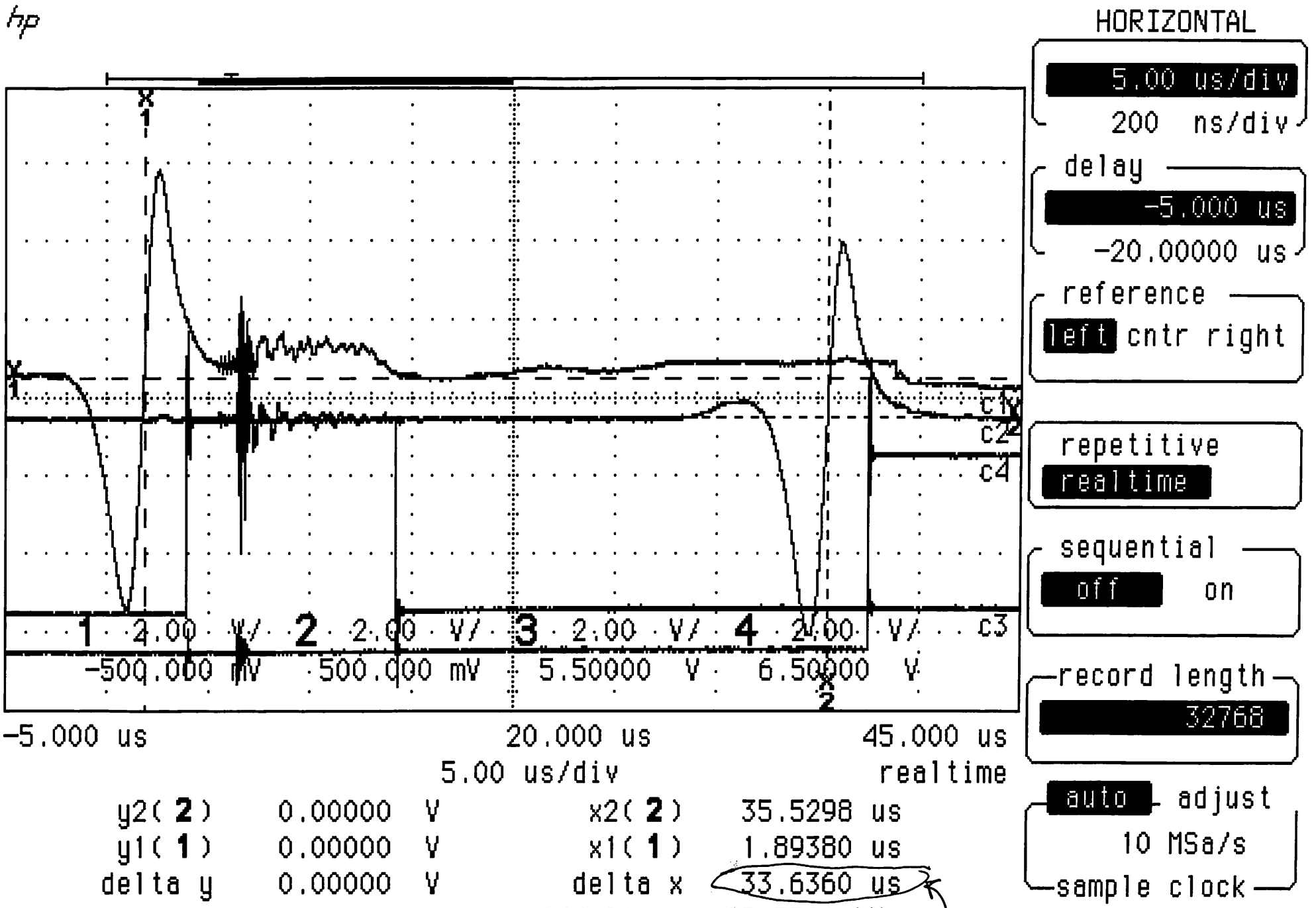


$224 \text{ peaks} \times \frac{1}{147.9993 \text{ MHz}} = 1514 \text{ ns}$

GS7 Shot 409

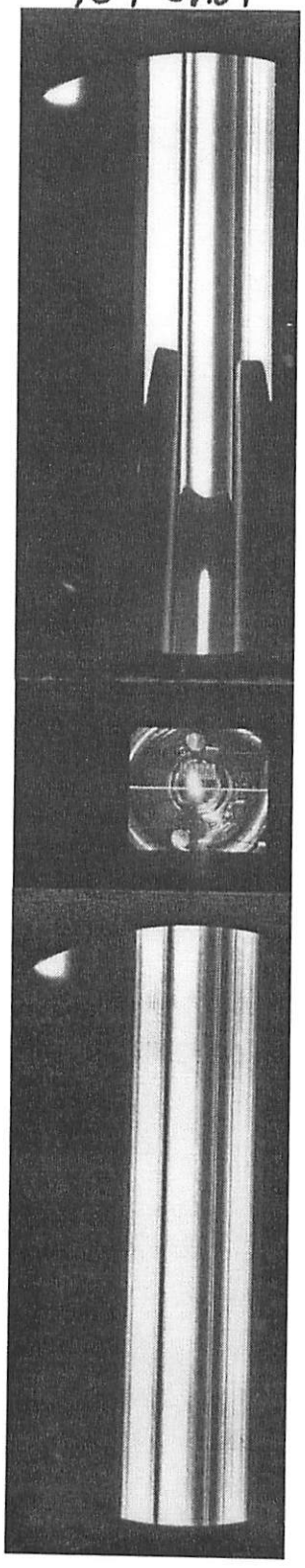

PRINTED : Jul-8-2010:14.36.02
PRODUCT : Classic 6500 S/N 84900024
TRC1Z:
(Jul-1-2010:16.04.01)
2V/div,10µs/div
TRC4Z:
(Jul-1-2010:16.04.01)
2V/div,10µs/div
TRC3Z:
(Jul-1-2010:16.04.01)
5V/div,10µs/div
camera trig to camera monitor out interval: 284ns
TR3Z
CURSOR :TRC2 -6.38V
+320.4178µs
CURSOR :TRC1 -187.5V
+68.22700µs
CURSOR :TRC3 -1.33V
+68.22700µs
CURSOR :TRC4 -1.33V
+68.22700µs
magnet 1 to camera trig interval

HPS Slot 409

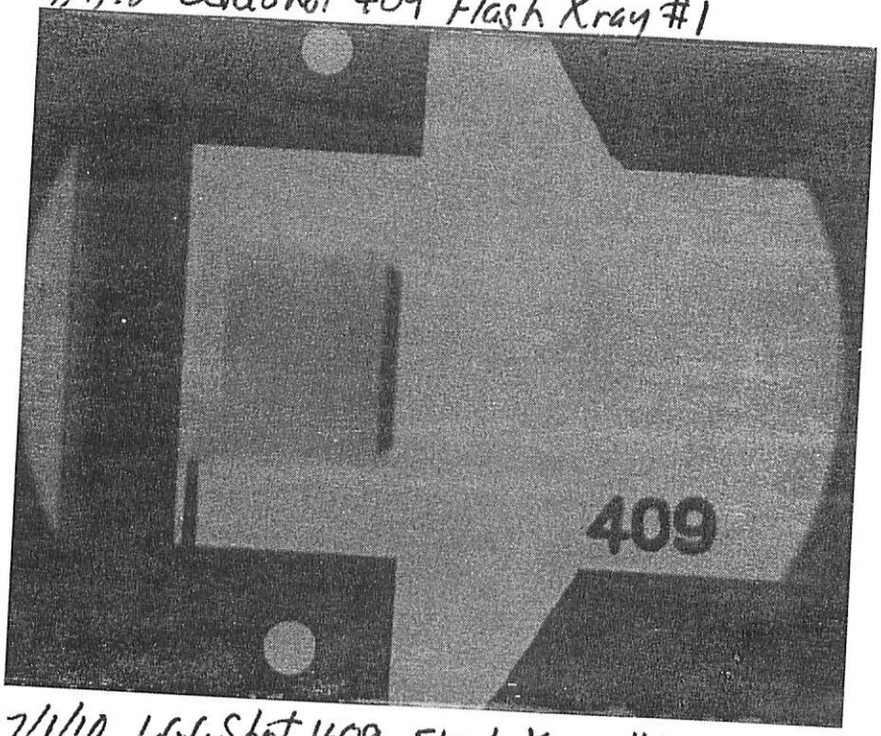


Velocity magnet 1 to 2 interval

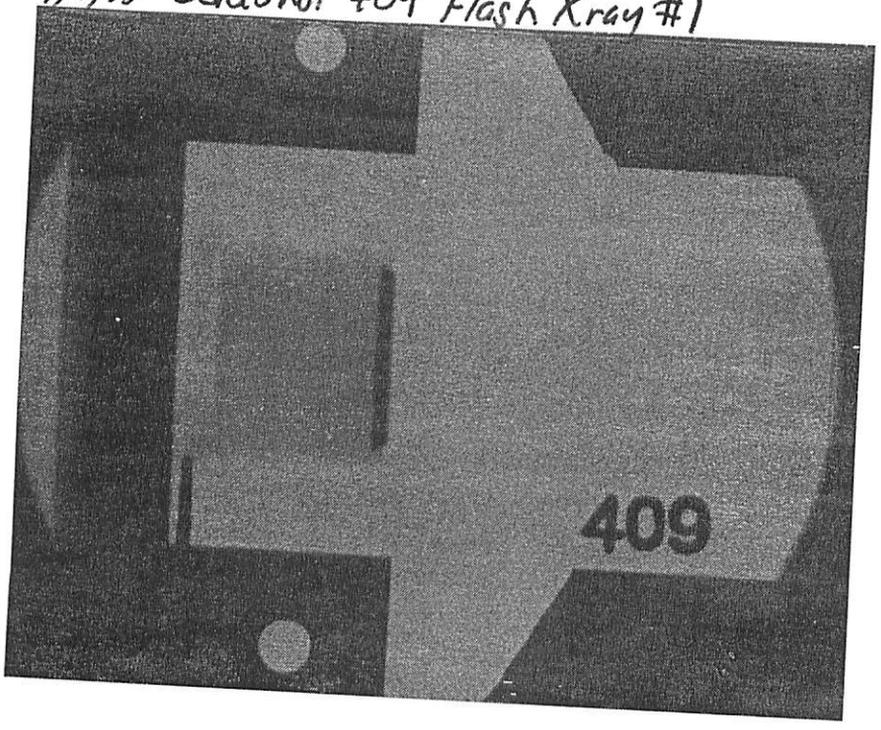
409 Shot



7/1/10 LaGShot 409 Flash Xray #1



7/1/10 LaGShot 409 Flash Xray #1



LIGHT GAS GUN DATA SHEET

Shot No. 412 Date 9/2/10

Target:

Sample Material FAYALITE Crystallographic orientation —

Source Location TAKA1 Thickness: 1 0.0804 in.

Type of Measurement EOS 2. 0.0801 in.

Bulk Density 4.3247 gm/cc Crystal Density 4.3947 gm/cc

±2 std. devs. 0.0460 gm/cc ±2 std. devs. 0.0015 gm/cc

Total Shorting Pin Height 0.070 in. (shim to driver) Driver Plate Thickness 0.0206 in.

Material Ta

Projectile:

Weight 18.37 gms. Length 0.9180 in. Skirt Diameter 0.9890 in.

Flyer Plate Material Ta Leading Edge Dia. 0.9800 in.

Thickness 0.0603 in. Major Dia. 0.81350 in. Depth Inserted 2 in.

Minor Dia. 0.8130 in. 85 lbs force

Barrel Dimensions:

Breech Diameter 0.9865 in. Muzzle Diameter 0.980 in. Taper 0.0065 in.

Ellipticity @ projectile depth insertion point 0.002 in.

Piston:

Weight 10 lb. Length 20.5 in. O-ring Groove Depth .112 in.

Diameter: Front 3.495 in. Back 3.497 in.

Pump Tube:

Pre-Fill Pressure -29 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 1063 gms. Type IMR 4350 Total Charge 1075 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 7.2 km/sec Piston 0.71 km/sec

Notes:

L.G.G.

Camera Streak Duration: 459 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: Position 4

Camera Slit Size: 25 µm Target to film magnification 0.80

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 1.07 µsec Flash X-ray #2 50.56 µsec

Static Streak Photo 6.63 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0379 in. min.	0.0936 in. min.
0.0381 in. max.	0.0953 in. max

Expected Burst Pressure 9k psi

Instrument Tank/Vacuum Pump Pressure: 57/53 µm

Distances:		
	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.48 cm
	Velocity Magnet #1 to #2	31.71 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.743 km/sec

Piston Velocity from Gauge #1 to #3: 0.748 km/sec

Projectile Velocity from X-ray: _____ km/sec.

7.053

L.G.G.

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	410 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	815 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	28.7 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	49.341 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	Target Impact Pins	54.951 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	Target Impact Pins	5.615 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	49.344 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	28.69 µsec
UDC Velocity:			7096.10 M/sec

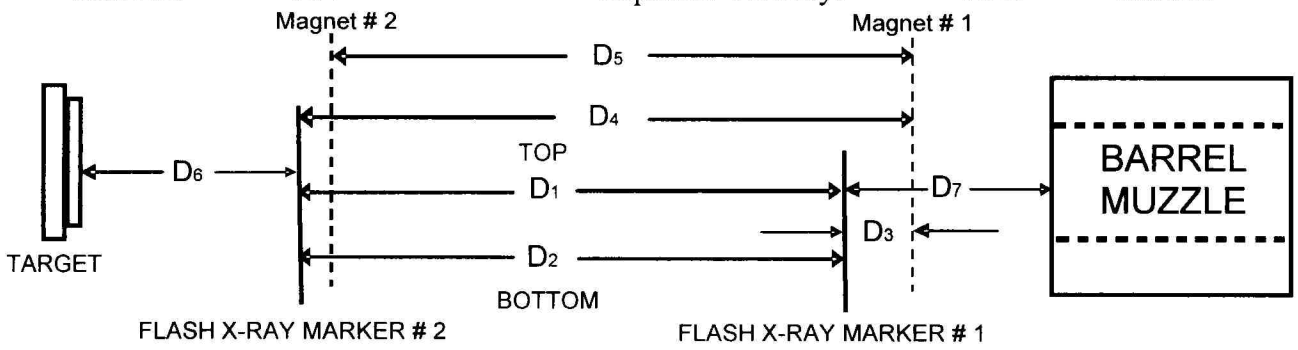
OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 1.5646	Velocity magnet 2 30.2554	28.691 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start 3.6486	2.084 µsec
HP5, ~~3~~ 2-4:	~~TTL Start~~ Magnet 2	TTL Stop 32.3400	2.085 µsec
HP6, 1-2:	Velocity Magnet 1	Xenon Lamp Trigger	— µsec
HP6, 2-3:	Xenon Lamp Trigger	Camera Trigger	— µsec
GS7, 1-2:	Pin Closure	Camera Trigger Signal	52 nsec
GS7, 1-3:	Pin Closure	Camera Ramp (mon. out.)	147 nsec
~~GS7, 1-4:~~	~~Pin Closure~~	Driver ~~Transducer~~ Signal	~~nsec~~

scope files corrupted

TARGET MEASUREMENT

Shot No. **412** Expected Velocity: **7.20** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	35.0	99.0
Measure # 2, mm	30.00	383.15	203.66	34.5	99.0
Average, mm	30.00	383.15	203.61	34.8	99.0
Travel time, µsec	**4.17**	**53.21**	**28.28**	**4.83**	**13.75**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **49.06** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **49.04** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **1.07** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **50.56** µsec.

MAGNET DISTANCE

Shot No. **412** Expected Velocity: **7.20**

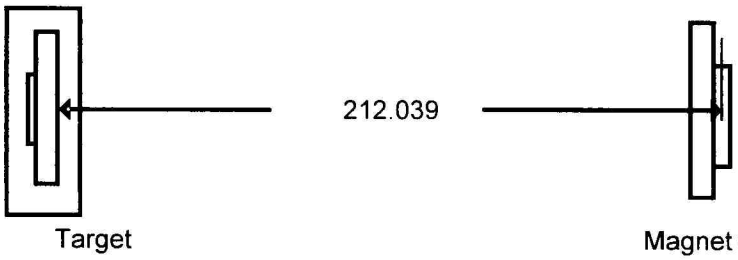
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **28.279 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.222 inch

Second measurement = 8.224 inch

Average measurement = 8.223 inch

Average measurement = 208.864 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

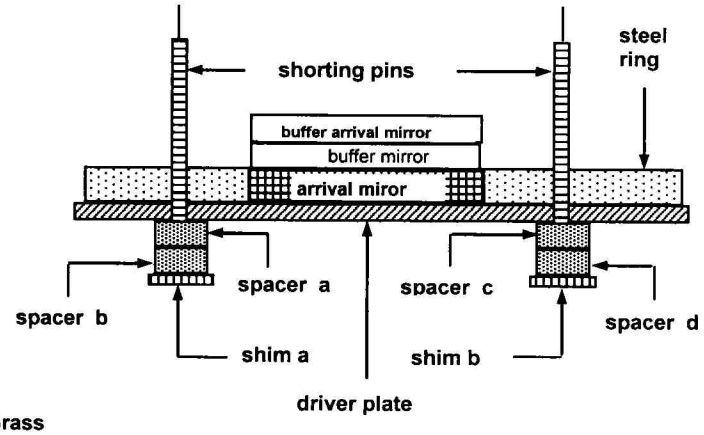
Distance Between Magnet # 2 to Target = 212.039 mm

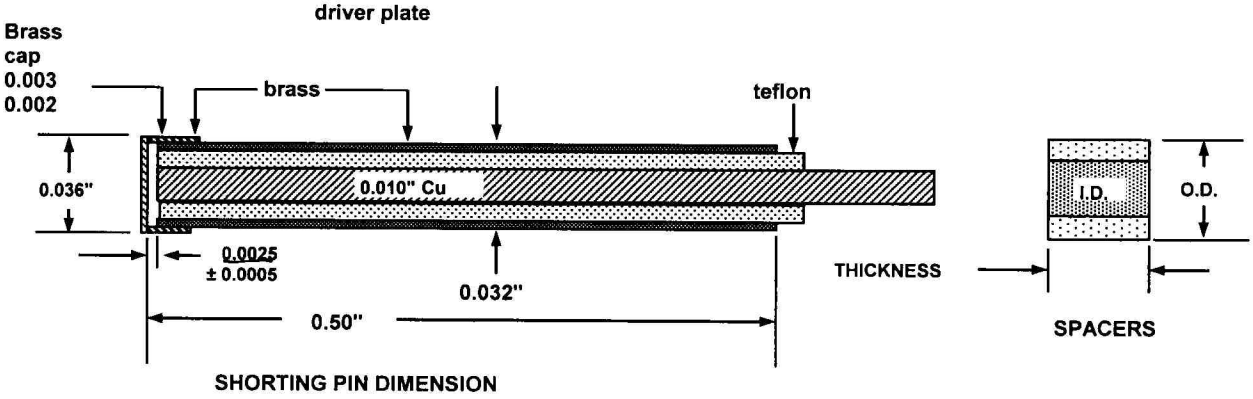
TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **29.450 µsec.**

Fudged Distance between Magnet 2 to Target = 0 mm

L.G.G. EOS TARGET ASSEMBLY SHEET

SHOT No. 412





Sample = **Fayalite (Fe_2SiO_4)**
Source = **Takai**

ARRIVAL MIRRORS:	a		b
Material =		**Fused Quartz**	
Height =	0.251		0.251
Width =	0.326		0.314
Thickness =	0.041		0.041

BUFFER MIRROR:	a
Material =	**Fused Quartz**
Height =	0.254
Width =	0.341
Thickness =	0.042 → 1.067mm

BUFFER ARRIVAL MIRROR:	a
Material =	**Fused Quartz**
Height =	0.253
Width =	0.138
Thickness =	0.043

SHIMS	a	b
Material =	**Stainless Steel**	
Height =	0.068	0.075
Width =	0.070	0.080
Thickness =	0.010	0.010

SPACERS:	a	b	c	d
Material =	**Stainless Steel**			
Inside diameter =	0.037	0.037	0.037	0.037
outside diameter =	0.062	0.062	0.062	0.062
Thickness =	0.031	0.030	0.030	0.030

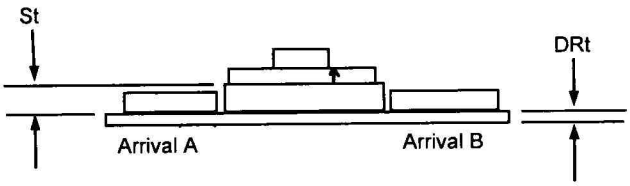
STEEL RING:	
Material =	**Mild Steel**
Inside diameter =	1.0075
outside diameter =	1.2440
Thickness =	0.1000

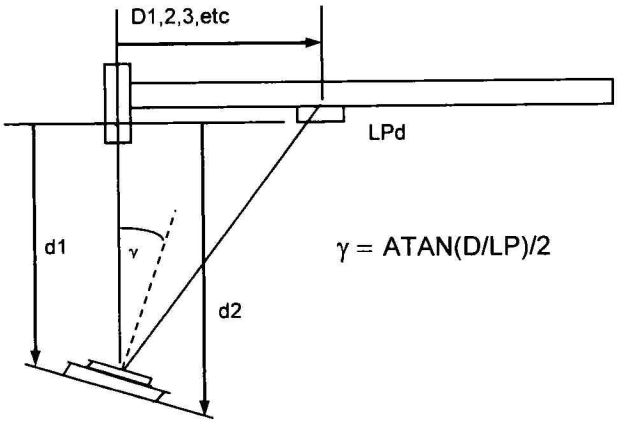
Note: All measurement are in inches

All measurement Done by E. Gelle

L.G.G. TARGET MIRROR ANGLE MEASUREMENT

Shot No. 412
Sample Material: Fayalite





DRt =	0.0217	inches	0.5512	mm
St =	0.1562	inches	3.9675	mm
LPd =	1.822	inches	46.2788	mm
Bt =	0.0529	inches	1.3437	mm
d1 =	681.5	mm		
d2 =	688.5	mm		
dave =	685	mm		

ARRIVAL MIRRORS LP = (d1 + d2)/2 + LPd - DRt = 730.7276

A:	D =	14.52	cm		145.2	mm
				γ =	5.62	degrees
B:	D =	14.71	cm		147.1	mm
				γ =	5.69	degrees

BUFFER MIRROR(S) LP = [(d1 + d2)/2 + LPd - DRt] - St = 726.7601

A:	D =	14.62	cm		146.2	mm
				γ =	5.69	degrees
B:	D =	0.00	cm			mm
				γ =	0.00	degrees

BUFFER ARRIVAL MIRROR LP = [(d1 + d2)/2 + LPd - DRt - St] -bt = 725.4164

A:	D =	14.57	cm		145.7	mm
				γ =	5.68	degrees

INCLINED MIRROR LP = [(d1 + d2)/2 - DRt - St] - [0 to 2 mm] = -6.5187

	D =	0.00	cm	0	mm	Reflection off of glass surface
				γ = 0.00	degrees	
	Wedge Angle β =		0	degrees	(From previous measurement)	

d1 =	0	mm	Make sure the main reflection returns to source.
d2 =	0	mm	Note whether other mirror reflections do not return to source
dave =	0	mm	

Inclination Angle

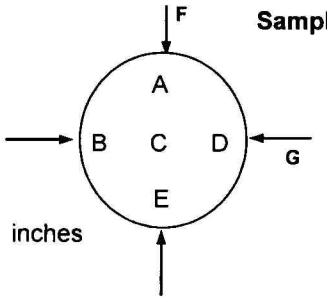
α = γ (Inclined Mirror) - β = 0.00 degrees $(\Delta\gamma)_{max}$ = 0.07 degrees

wanted α = degrees degrees

MATERIAL: Fayalite sample - Shot 412

Measurement done by: Russ O. **Date:** 8/10/2010

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT		
A	0.08035	F	0.34650	
A	0.08015	F	0.34400	
B	0.08020	G	0.30350	
B	0.08015	G	0.30750	
C	0.08020	**AVE**		**0.32538**
C	0.08040			
D	0.08030	Fave		0.34525
D	0.08030	Gave		0.30550
E	0.08010	Fstd		0.002
E	0.08015	Gstd		0.003
	0.0803			



Sample is elliptical in shape

inches

Volume elliptical cylinder 0.006646172

Error 7.0748E-05

Statistic for thickness

N	10	
MAX	0.08040 inch	2.04216 mm
MIN	0.08010 inch	2.03454 mm
Range	0.00030 inch	0.00762 mm
MEAN	0.08023 inch	2.03784 mm
STDEV	9.42546E-05 inch	0.00239 mm

Statistic for Diameter

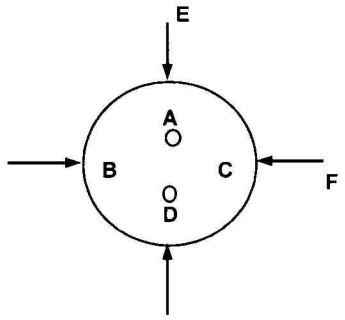
N	4	
MAX	0.34650 inch	8.80110 mm
MIN	0.30350 inch	7.70890 mm
Range	0.04300 inch	1.09220 mm
MEAN	0.325375 inch	8.26453 mm
STDEV	0.023030324 inch	0.58497 mm

DENSITY MEASUREMENT BY:		**Russ Oliver**				
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.1	1.88509	0.47100	2.26340	0.8646	4.3935
2	21.1	1.88506	0.47103	2.26341	0.8646	4.3943
3	21.1	1.88506	0.47100	2.26343	0.8646	4.3964
	THICKNESS:		0.08023	±	mm	
	FLATNESS:		0.00030	mm		
	VOLUME:		0.1089	0.0012	cm^3	uses area of ellipse
	CRYSTAL DENSITY:		4.3947	0.0015	$grams/cm^3$	
	BULK DENSITY:		4.3247	0.0460	$grams/cm^3$	corrected error calculation
	DENSITIES CHECKED BY: _____					
	MEASUREMENT CHECKED BY: ___					

SHOT No. _ 412 8/11/2010
Tantalum Driver Plate
SAMPLE MATERIAL: Ta

Thickness Measurement

A	0.02075
A	0.02070
B	0.02075
B	0.02065
C	0.02055
C	0.02045
D	0.02045
D	0.02050



Diameter Measurement

E	1.37700
E	1.37700
F	1.37700
F	1.37700
AVE	1.377
Radius	0.6885

Statistic for thickness

N	8
MAX	0.02075 in
MIN	0.02045 in
Range	0.00030 in
MEAN	0.0206 in
	0.0523 mm
STDEV	0.000128174 in

Statistic for perimeter

N	4
MAX	1.377
MIN	1.377
Range	0
MEAN	1.377
STDEV	0

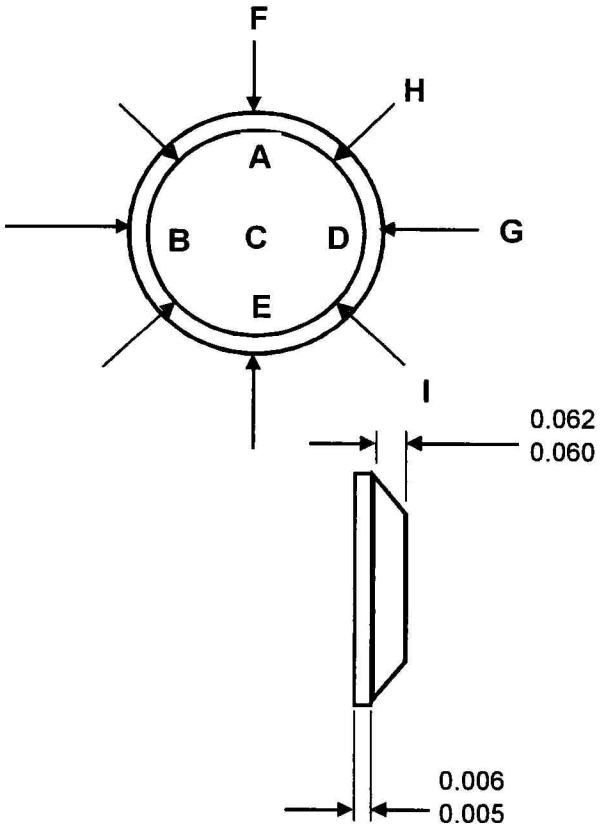
DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88640	8.20059	9.66042	0.8640	16.6096
2	21.8	1.88642	8.20062	9.66044	0.8640	16.6085
3	21.8	1.88643	8.20064	9.66047	0.8640	16.6086
	THICKNESS:		0.0206	±	mm	
	FLATNESS:		0.00030	mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		16.6089	6.28E-04	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	
	DENSITIES CHECKED BY:			on		
	MEASUREMENT CHECKED BY:			on		

SHOT No.

FLYER PLATE MATERIAL: **Ta # 23** 4/26/2010

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06040	F	0.81350
A	0.06035	F	0.81300
B	0.06035	G	0.81300
B	0.06045	G	0.81300
C	0.06050	H	0.75000
C	0.06045	H	0.75000
D	0.06030	I	0.75000
D	0.06035	I	0.75000
E	0.06040		
E	0.06040		



Statistic for thickness

N	10	
MAX	0.06050	
MIN	0.06030	
Range	0.00020	
MEAN →	0.060392857	inch
	1.533978571	mm
STDEV	7.31925E-05	

Statistic for Diameter (F-G)

N	4	
MAX	0.81350	
MIN	0.81300	
Range	0.00050	
MEAN	0.8131250	inch
	20.6533750	mm
STDEV	0.00025	

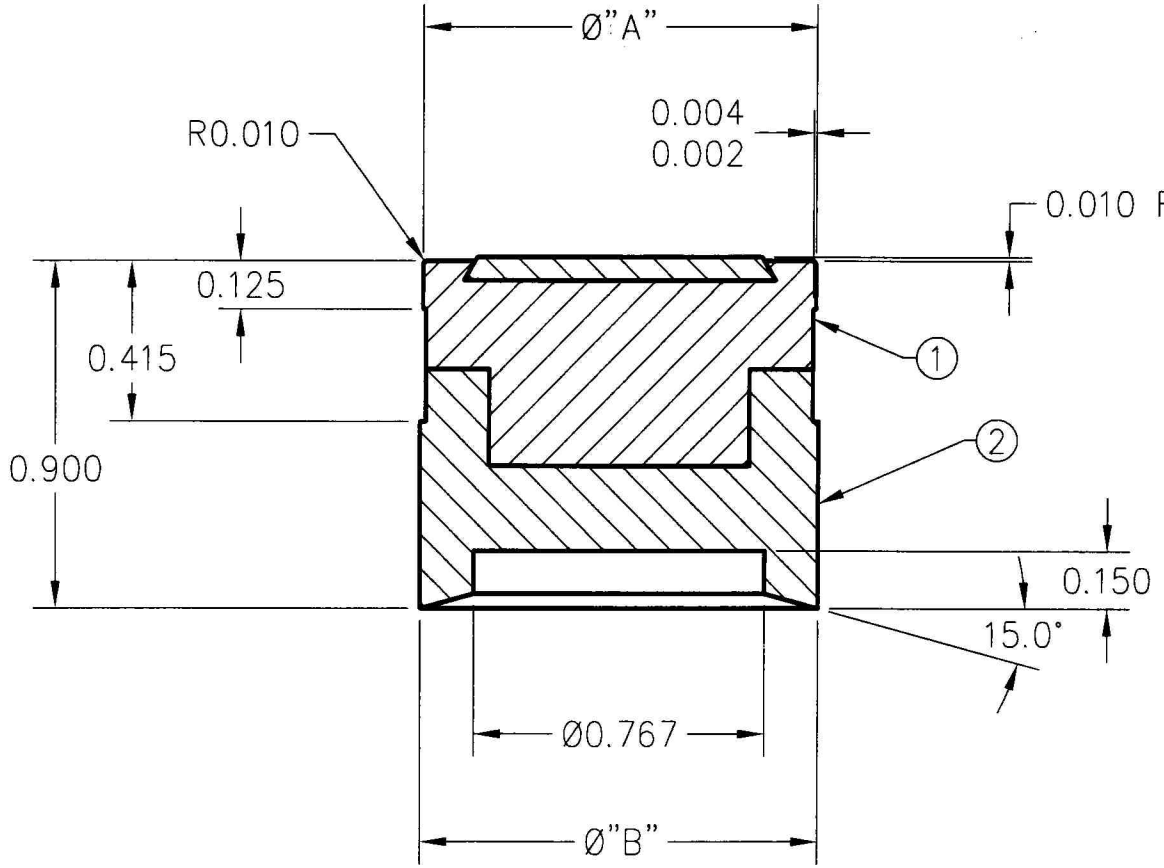
Statistic for Diameter (H-I)

N	4	
MAX	0.75000	
MIN	0.75000	
Range	0.00000	
MEAN	0.75	inch
	19.05	mm
STDEV	0	

DENSITY MEASUREMENT BY:			Russ	4/23/2010		
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.9	1.88223	7.96829	9.43725	0.8639	16.6565
2	21.9	1.88225	7.96835	9.43726	0.8639	16.6539
3	21.9	1.88220	7.96837	9.43731	0.8639	16.6571
	THICKNESS		0.060392857	±	in	
	FLATNESS:		0.00020	in.		
	VOLUME:		0.5139	9.17E-04	cm^3	
	CRYSTAL DENSITY:		16.6558	1.74E-03	$grams/cm^3$	
	BULK DENSITY:		15.5052	9.18E-04	$grams/cm^3$	

DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED BY: _____ on _____



Note: Super Glue & Press Fit 1 & 2

Tq 0.0604 8/13/10

as built

0.9800

0.9894

SHOT# 412			
A	0.9800	+.0000 −.0005	
B	0.9890	+.0005 −.0000	

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-048	1
1	Sabot & Flyer Plate	LGG-049	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

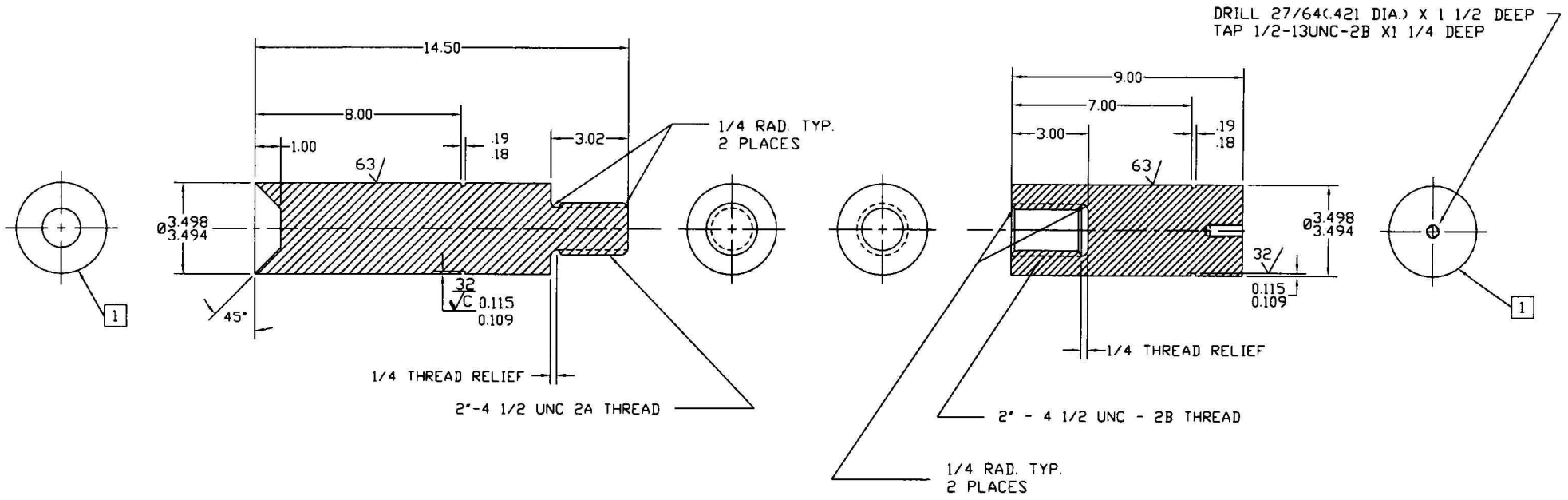
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long DATE 1/23/04
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE
Projectile Assy.

FINISH 16
MATERIAL Zelux-M&HDP
SCALE 2:1
SHEET 2 of 2
A
DRAWING NUMBER LGG-050



FRONT

MATERIAL: HIGH DENSITY POLYETHYLENE

REAR

MATERIAL: MECHANICAL GRADE TEFLON

NOTES:

[1] TURN FINAL DIAMETER WITH PARTS SCREWED TOGETHER

LTR	REVISION	DATE

UNLESS OTHERWISE SPECIFIED
TOLERANCES

.###	±.005	FRACTIONS	1/64
.##	±.01	ANGLES	±1/2°

CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN	JEFF BATTEN	DATE 9/2/92
ENGINEER		DATE
APPROVED		DATE
CONTRACT		

CALIFORNIA INSTITUTE OF TECHNOLOGY
SEISMOLOGICAL LABORATORY

TITLE
LGG PISTON - 2 PIECE

FINISH	SCALE	SIZE	DRAWING NUMBER
	1:3	C	14457

Shot 412 Nominal Timeline Preshot

V	[redacted]	m/s	
cable time	90	150	ns
intervalometer intrinsic delay	2140	2140	ns
UDC extra count lag	123	ns	
pulse translator delay	150	ns	
X-ray 1 program delay	[redacted]	ns	
X-ray 2 program delay	[redacted]	ns	
X-ray 1 pulser delay	490	ns	For Simulation, set
X-ray 2 pulser delay	490	ns	UDC HV#2 Delay
Camera delay to start of ramp	100	ns	[redacted]
Start of ramp to visible streak	25	ns	UDC HV#3 Delay
Streak duration	[redacted]	ns	[redacted]
Lamp trigger offset time	[redacted]	ns	UDC HV#4 Delay
TM-11 to lamp bright	6625	ns	[redacted]
Desired Spark-Streak Delay	[redacted]	ns	

M1-M2 distance	0.203606	Pin shim	0.000254 m
M2-target distance	[redacted]	Pin spacer	[redacted] m
M2-target fudge	[redacted]	Pin cover	0.0000635 m
M1-fid1 distance	0.03	Pin gap	0.0000635 m
M1-fid2 distance	0.353145	Intrinsic Pin time	37.3461307 ns
Flyer thickness	[redacted]	Pin box delay	57 ns
Programmed Delay or long cable to camera			[redacted] ns

Us(driver)	7998.2	Us (sample)	11101.7573
driver thickness	[redacted]	sample thickness	[redacted]
driver time	65.4197194	sample time	183.56031
		Us(buffer)	10956.8079
		buffer thickness	[redacted]
		buffer time	97.3641235

t (ns)	flyer x (m)	shock front (m)	event
0	0.00076699		M1 zero-crossing
150	0.00184699		HP5-1, Intervalometer start
2290	0.01725499		HP5-3, UDC start, signal to pulse translator
2440	0.01833499		pulse translator out to X-ray 1 & 2 delay amps
2530	0.01898299		GS7 trig
3510	0.02603899		X-ray 1 delay amp out to counters 4, 5
4090	0.03021499		X-ray 1 fires
4180	0.03086299		X-ray 1 pulse monitor at counter 4b
28279	0.20437299		M2 zero-crossing
28429	0.20545299		HP5-2, Intervalometer stop
30569	0.22086099		HP5-4, UDC stop
50854	0.36691829		UDC HV#3, HP6-2
51004	0.36799829		Pulse Translator out#3
51094	0.36864629		Trigger TM-11
53000	0.38236699		X-ray 2 delay amp, stop counter 4, start counter 6
53580	0.38654299		X-ray 2 fires
53670	0.38719099		X-ray 2 pulse monitor at counter 4b
57356	0.41373269		UDC zero point
57479	0.41461829		UDC HV#1, HP6-1Trig
57569	0.41526629		GS7-1
57719	0.41634629		Lamp bright enough to streak
57375	0.413867		PIN IMPACT
57412	0.41413589		Pin closure
57379	0.41389829		UDC HV#2: Sim Trigger to Camera, HP6-3
57469	0.41454629		pin box out to delay unit(?)
57469	0.41454629		GS7-2
57469	0.41454629		Delay cable crossed, Camera Trigger Received from UDC
57594	0.41544629		Begin Visible Streak
57569	0.41526629		Camera Monitor shows Begin Streak on GS7-3
57597	0.41546802		UDC HV#4 out
57687	0.41611602		Cal port signal, GS7-4
57622	0.415645	0	IMPACT
57687		0.00052324	Driver arrival on streak, Cal sig on sim
57871		0.002561082	Sample cutoff on streak
57968		0.003627882	Buffer cutoff on streak
58053		0.003450437	End Streak

UDC upcount	28279

Driver Cutoff Sensitivity For SHOT

dT/dV	-0.039643	
		Driver Cutoff
V+5%	7560	79.3894938
V-5%	6840	107.997688

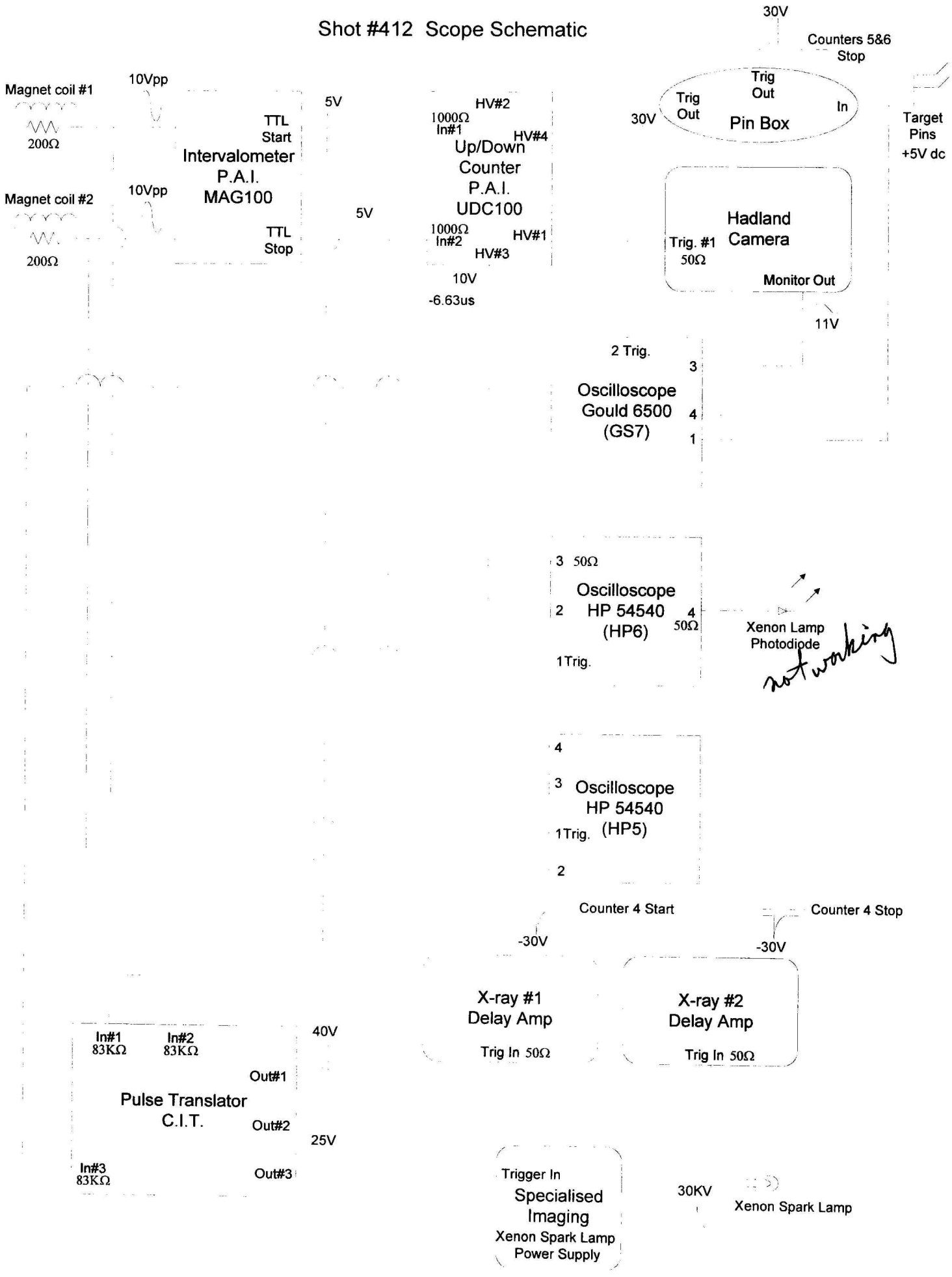
	ns
Streak start	0
Driver cutoff on streak	93
Sample cutoff on sreak	277
Buffer cutoff	374
Streak end	459

	ns
Spark start	0
streak start	6500
streak end	6959
Spark end	24000

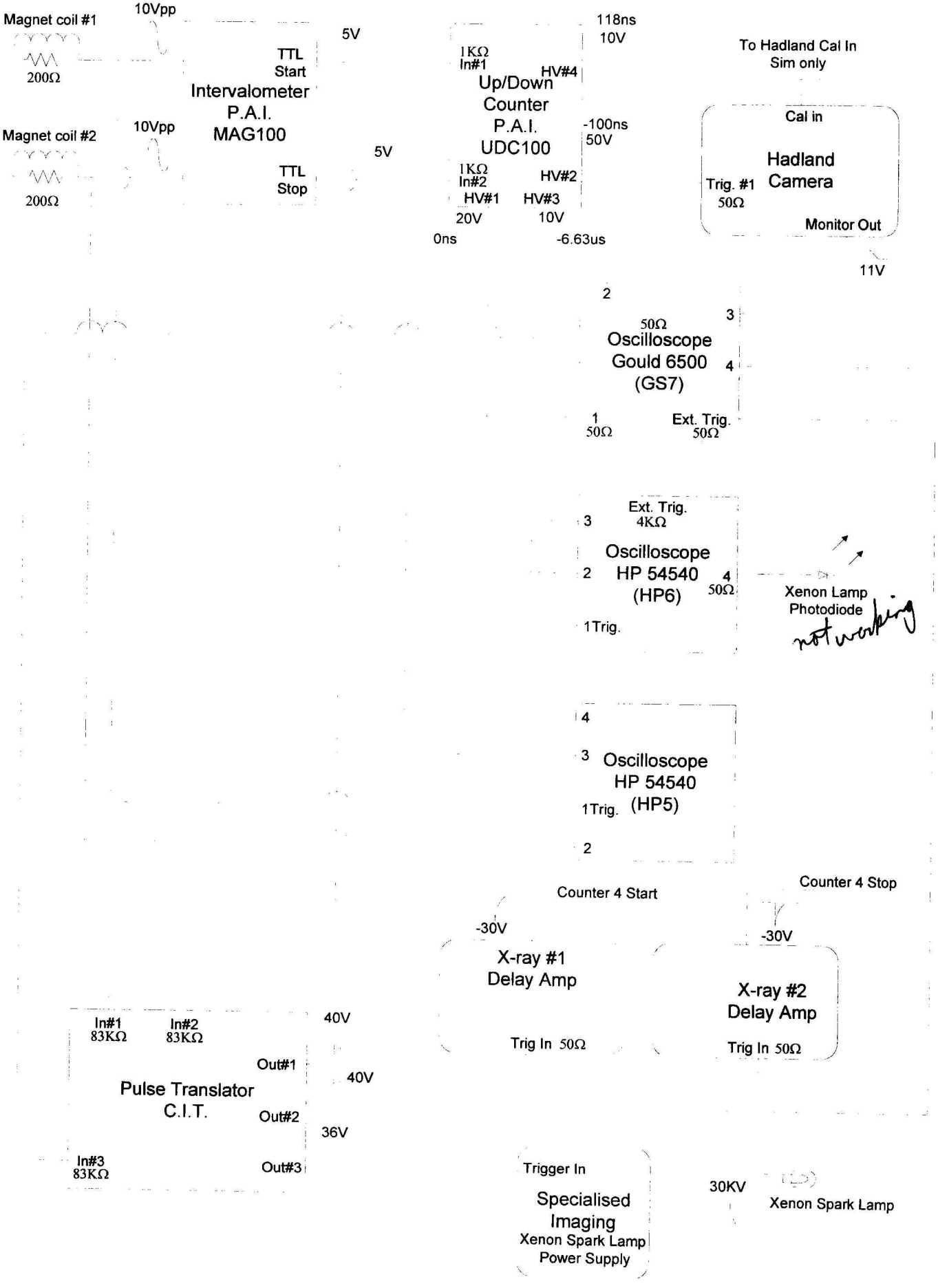
Instructions:
Red cells are inputs for a given shot
Blue cells are constants
Yellow cells are calculations
Green cells are outputs to be used in shot setup

If "Driver cutoff on streak", cell I39, is too high, enter a Programmed Delay in cell K9 and use Delay unit.
If "Driver cutoff on streak", cell I39, is too low, use a larger Pin Spacer

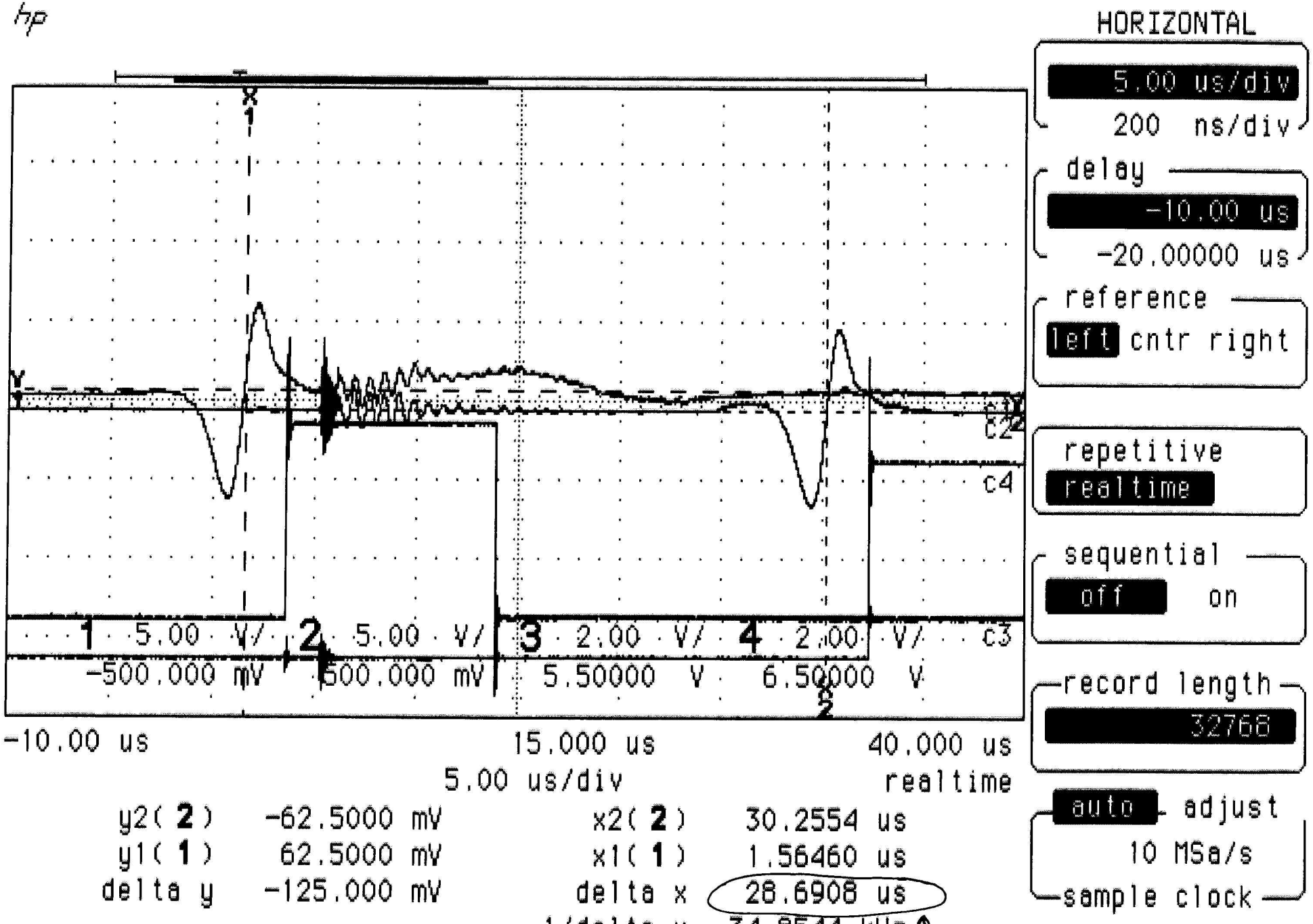
Shot #412 Scope Schematic



Simulation for Shot #412 Scope Schematic

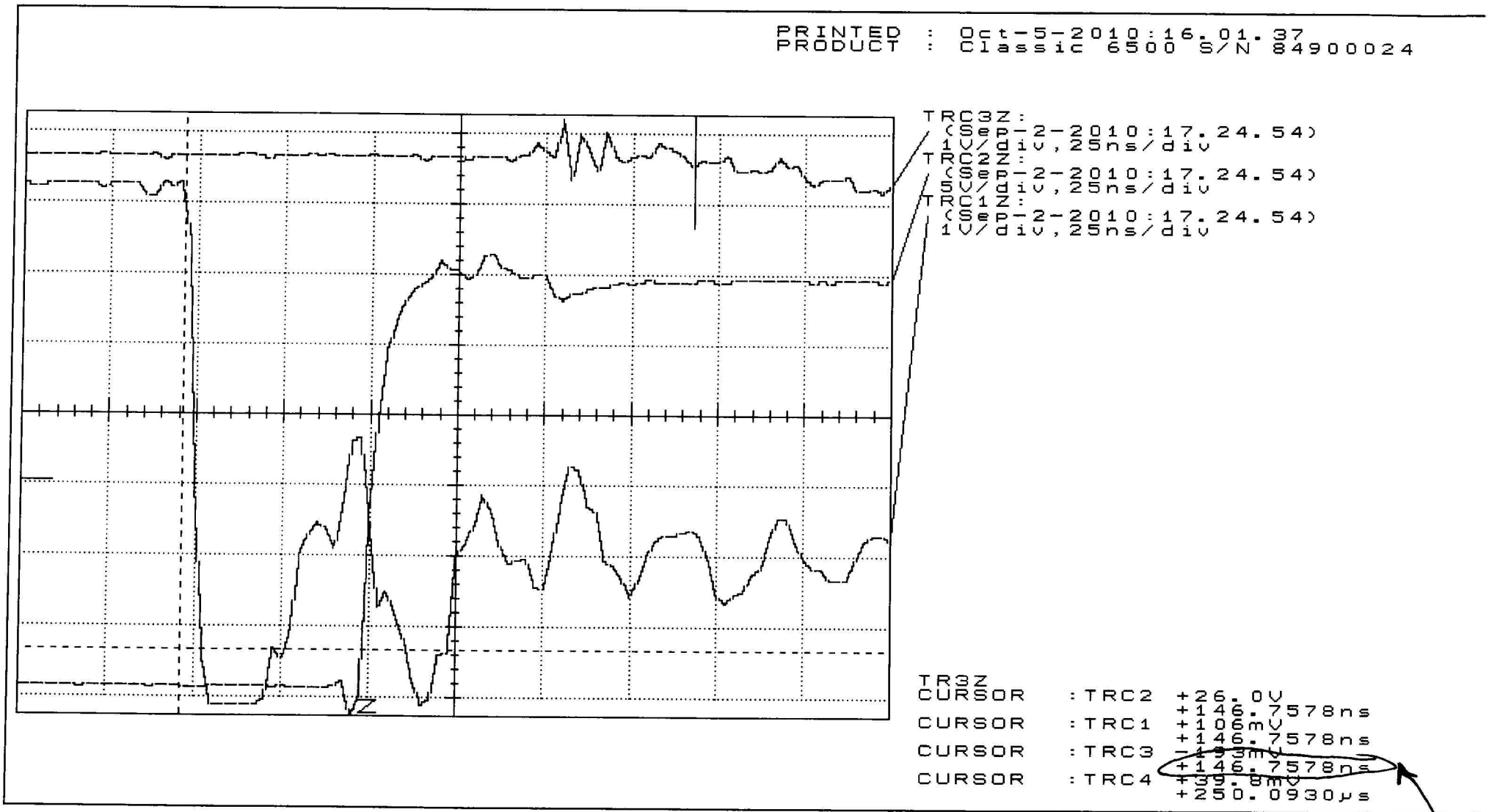


HP5 Shot 412



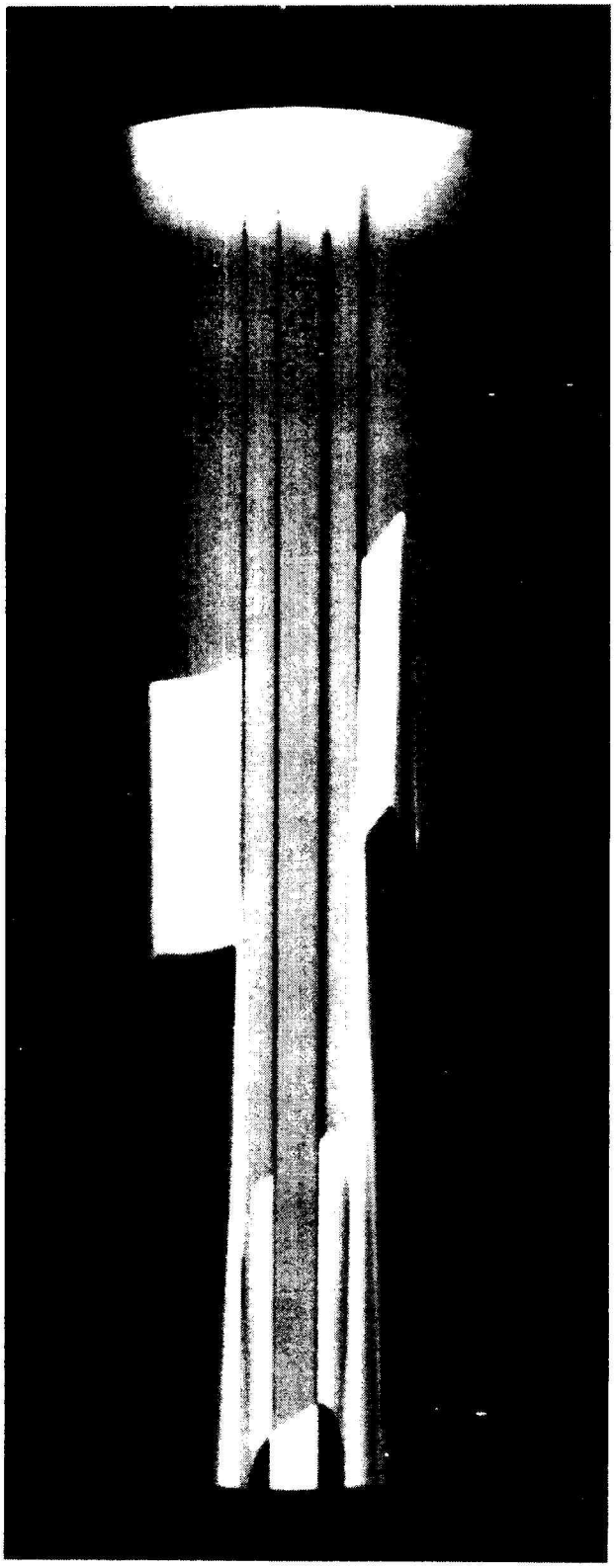
Magnet 1 to 2 interval

GST Shot 412

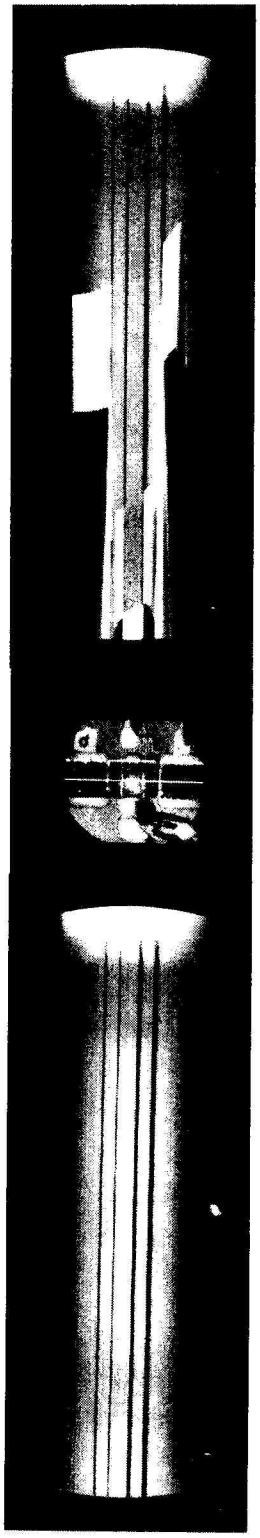


Pin closure to Camera Monitor ramp

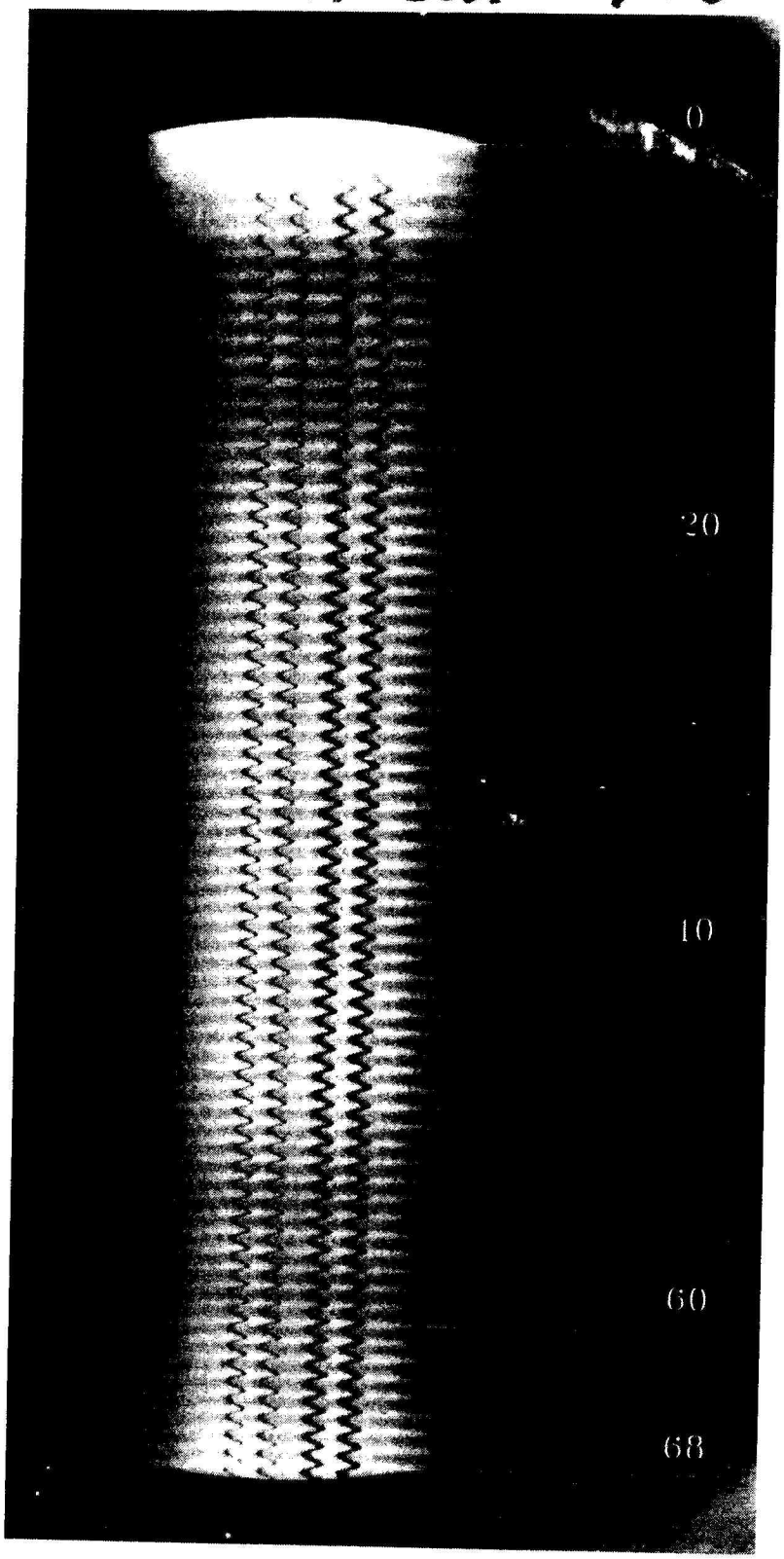
Shot 412



Shot 412

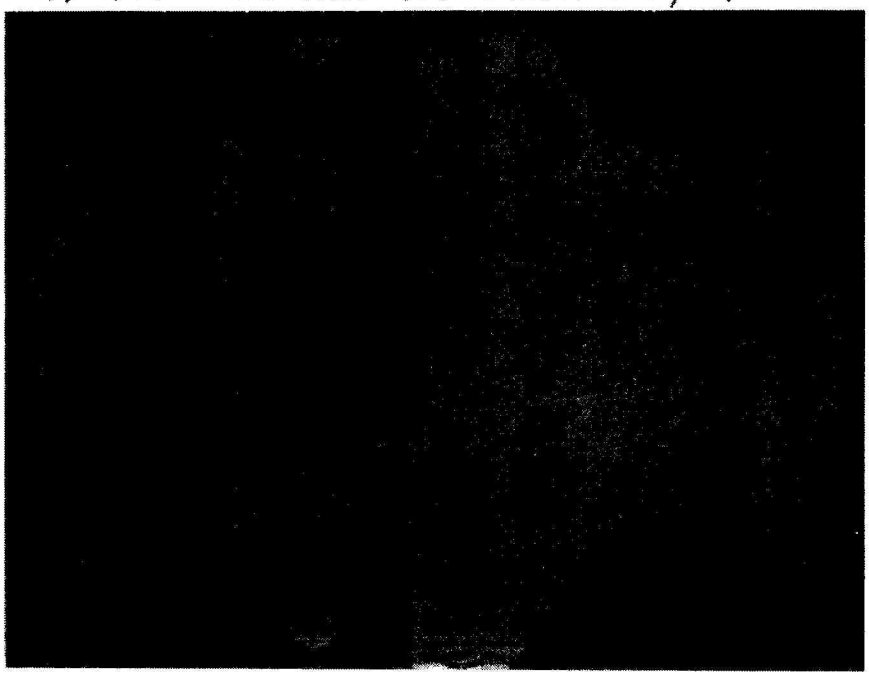


Cal Streak 412

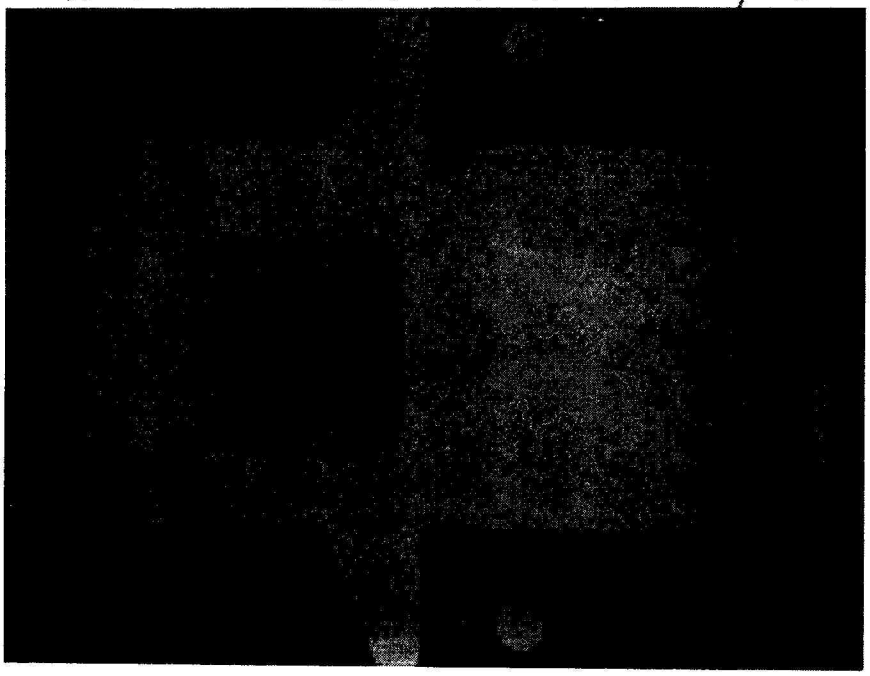


68 × 6.757 ns/cycle = 459 ns streak duration

9/2/10 LGG Shot 412 Flash Xray #1



9/2/10 LGG Shot 412 Flash Xray #2



LIGHT GAS GUN DATA SHEET

Shot No. 413 Date 4/29/10

Target:

Sample Material HEDENBERGITE Crystallographic orientation _____

Source Location Univ. of Michigan Thickness:1 _____ in.

Type of Measurement _____ 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height — in. (shim to driver) Driver Plate Thickness _____ in. Material _____

Projectile:

Weight 12.07 gms. Length 0.9135 in. Skirt Diameter 0.9906 in.

Flyer Plate Material Al Leading Edge Dia. 0.9800 in.

Thickness _____ in. Major Dia. _____ in. Depth Inserted 2 in.

Minor Dia. _____ in. insertion force 75 lbs

Barrel Dimensions:

Breech Diameter 0.9874 in. Muzzle Diameter 0.980 in. Taper 0.0074 in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.108 in.

Diameter: Front 3.495 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure -29 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 463 gms. Type IMR 4350 Total Charge 475 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 4.5 km/sec Piston 0.51 km/sec

Notes: Desired pre heat temp: 1400°C
1400°C @ shot time

L.G.G.

Camera Streak Duration: 1500 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.88

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 3.57 µsec Flash X-ray #2 82.49 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0561 in. min.	0.0932 in. min.
0.0569 in. max.	0.0939 in. max

Expected Burst Pressure 4K psi

Instrument Tank/Vacuum Pump Pressure: 65/55 µm

Distances:

Muzzle to Flash X-ray Marker #1	9.9 cm
Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
Flash X-ray Marker #2 to Target	3.63 cm
Velocity Magnet #1 to #2	20.34 cm
Piston Velocity Gauge #1 to #2	30.48 cm
Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.526 km/sec

Piston Velocity from Gauge #1 to #3: 0.520 km/sec

Projectile Velocity from UDC: 4473.30 m/sec

Projectile Velocity from X-ray: _____ km/sec

4480

L.G.G. Shot 413

COUNTER CONNECTIONS

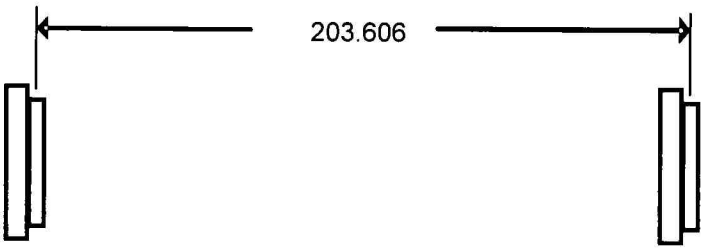
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	580 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1172 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	45.5 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	78.663 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	85.992 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.332 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	78.660 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	45.52 µsec
UDC Velocity:			4473.30 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 $x_1 = 2.7310$	Velocity magnet 2 $x_2 = 48.2664$	45.535 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start $x_3 = 4.7666$	2.036 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop $x_4 = 50.2840$	2.018 µsec
HP6, 1-2:	Velocity Magnet 1 $x_1 = 2.7286$	Xenon Lamp Trigger $x_2 = 80.2316$	77.503 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out $x_3 = 8.991$	X-ray 2 Pulser Monitor Out $x_4 = 87.6496$	78.658 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	91.814 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	92.097 µsec

MAGNET DISTANCE

Shot No. **413** Expected Velocity: **4.50**



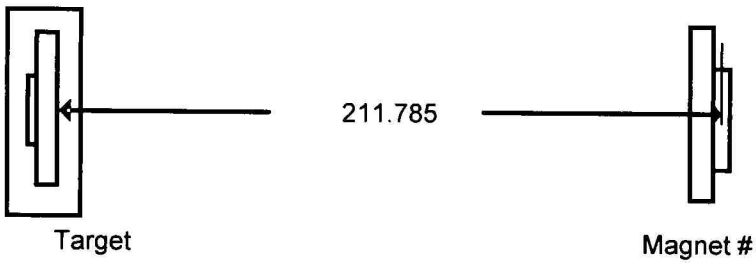
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **45.246 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.215 inch

Second measurement = 8.211 inch

Average measurement = 8.213 inch

Average measurement = 208.610 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

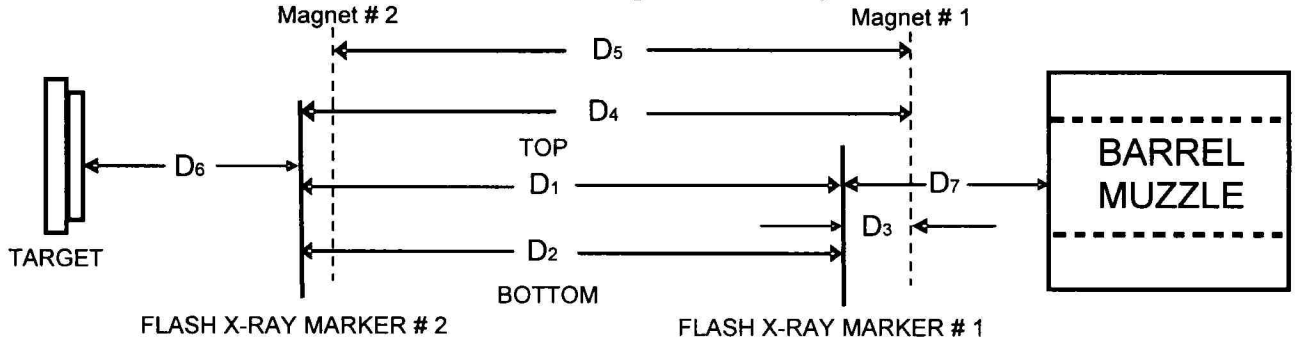
Distance Between Magnet # 2 to Target = 211.785 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **47.063 µsec.**

Fudged Distance between Magnet 2 to Target = ~~0 mm~~ 0.197541 m

TARGET MEASUREMENT

Shot No. **413** Expected Velocity: **4.50** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	36.5	99.0
Measure # 2, mm	30.00	383.15	203.66	36.0	99.0
Average, mm	30.00	383.15	203.61	36.3	99.0
Travel time, µsec	**6.67**	**85.14**	**45.25**	**8.06**	**22.00**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **78.49** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **78.46** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **3.57** µsec.

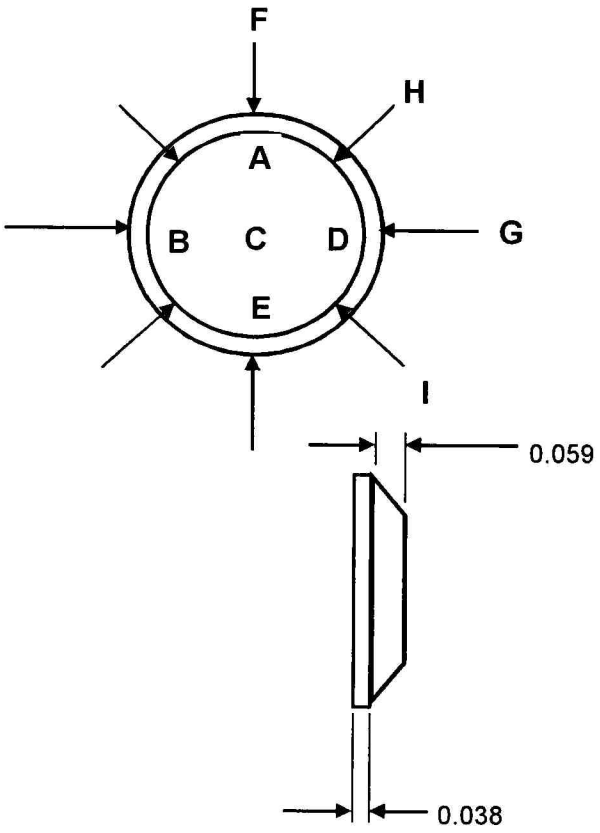
Flash X-Ray # 2 Delay (from Magnet # 1) **82.49** µsec.

SHOT No. 413

FLYER PLATE MATERIAL: Al -1

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.09750	F	0.82250
A	0.09745	F	0.82250
B	0.09750	G	0.82250
B	0.09730	G	0.82250
C	0.09705	H	0.75000
C	0.09715	H	0.75000
D	0.09735	I	0.75000
D	0.09740	I	0.75000
E	0.09740		
E	0.09730		



Statistic for thickness

N	10	
MAX	0.09750	
MIN	0.09705	
Range	0.00045	
MEAN	0.097314286	inch
	2.471782857	mm
STDEV	0.000162569	

Statistic for Diameter (F-G)

N	4	
MAX	0.82250	
MIN	0.82250	
Range	0.00000	
MEAN	0.8225000	inch
	20.8915000	mm
STDEV	0	

Statistic for Diameter (H-I)

N	4	
MAX	0.75000	
MIN	0.75000	
Range	0.00000	
MEAN	0.75	inch
	19.05	mm
STDEV	0	

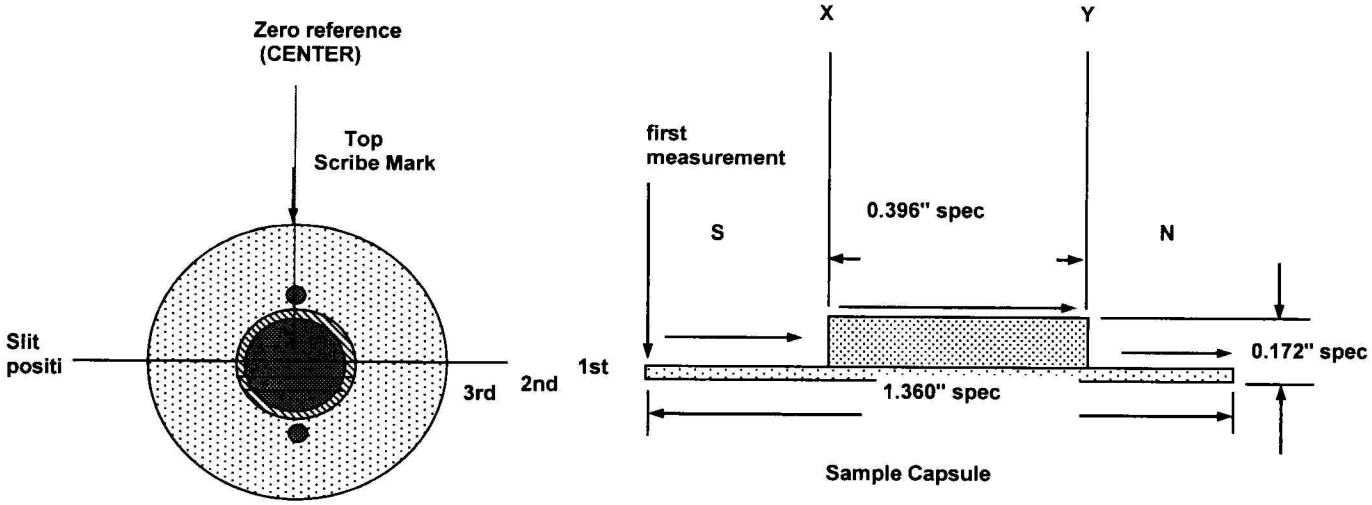
DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	20.6	1.88251	2.14530	3.34229	0.8651	2.7072
2	20.6	1.88255	2.14528	3.34286	0.8651	2.7094
3	20.6	1.88250	2.14532	3.34285	0.8651	2.7094
	THICKNESS		0.097314286	±		in
	FLATNESS:		0.00045	in.		
	VOLUME:		0.8473	4.13E-04		cm^3
	CRYSTAL DENSITY:		2.7087	1.27E-03		$grams/cm^3$
	BULK DENSITY:		2.5319	4.13E-04		$grams/cm^3$
	DENSITIES CHECKED BY: _____ on _____					
	MEASUREMENT CHECKED BY: _____ on _____					

SHOT No. _____
SAMPLE CAPSULE: _____5_____
SAMPLE MATERIAL: Hedenbergite

tip used: .7mm long/ flat tip
note: the platform on which the measurement was taken deviates from flat by +0.013 max.
direction of measurement

4.997
4.661

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = -0.00021

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = -0.00031

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = -0.00047

Note: Measurement from reference zero point from the base is = 0.1738 Inches
4.4133 mm

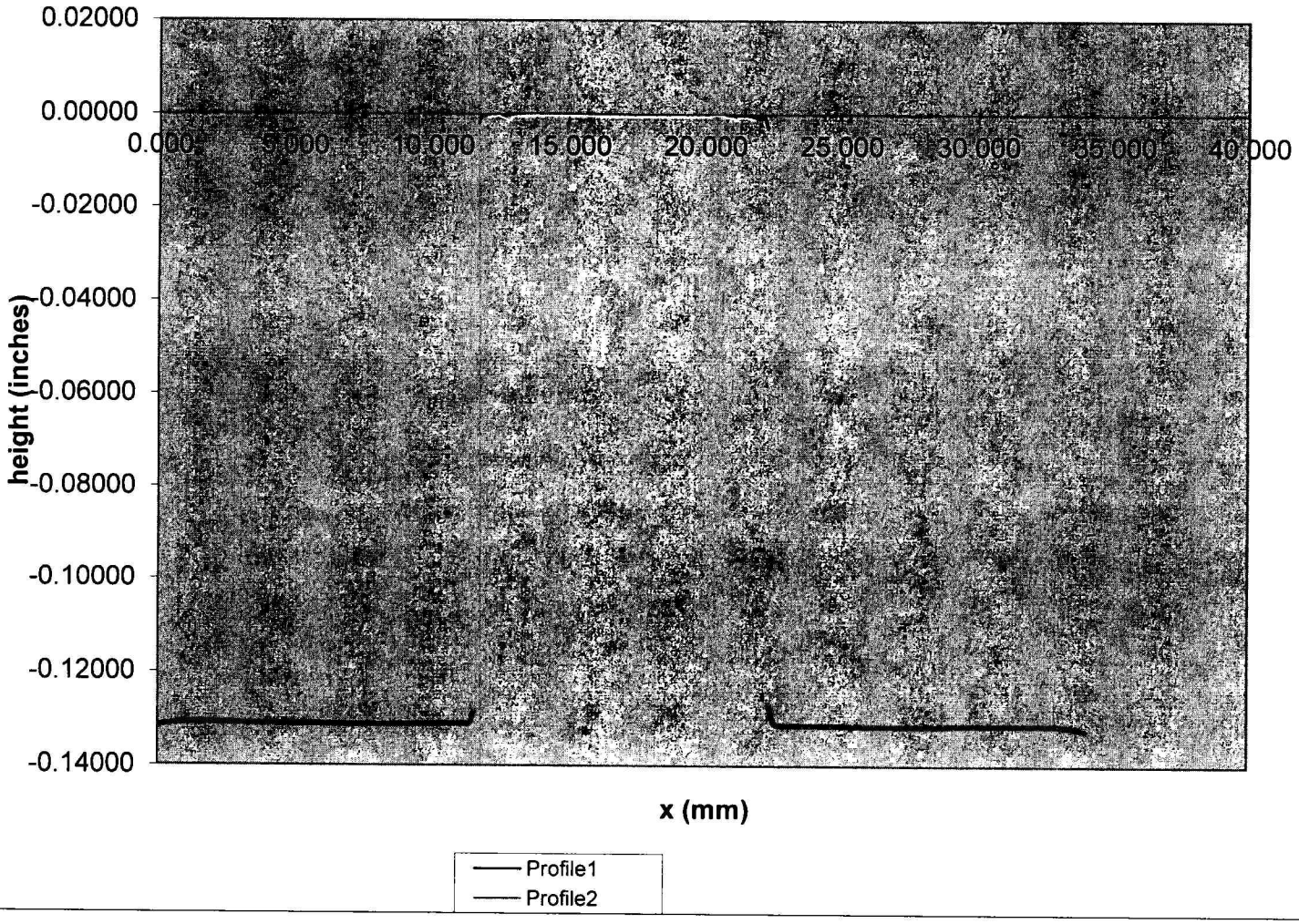
Average thickness of the driver Plate = 0.0425 Inches
1.0803 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the Carbon Deposited on the Projectile side is = nm

Distance from the top of the cap to the measured (avg) driver plate **0.13** Inches
3.33 mm

Shot # 409 Cap thickness profile Polish



1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading	Reading Distance mm
1	0.000	17.000	-0.1317	225	22.400	-5.400	-0.1268	118	11.700
2	0.100	16.900	-0.1315	226	22.500	-5.500	-0.1291	119	11.800
3	0.200	16.800	-0.1314	227	22.600	-5.600	-0.1309	120	11.900
4	0.300	16.700	-0.1313	228	22.700	-5.700	-0.1312	121	12.000
5	0.400	16.600	-0.1312	229	22.800	-5.800	-0.1313	122	12.100
6	0.500	16.500	-0.1311	230	22.900	-5.900	-0.1313	123	12.200
7	0.600	16.400	-0.1310	231	23.000	-6.000	-0.1313	124	12.300
8	0.700	16.300	-0.1310	232	23.100	-6.100	-0.1313	125	12.400
9	0.800	16.200	-0.1309	233	23.200	-6.200	-0.1313	126	12.500
10	0.900	16.100	-0.1309	234	23.300	-6.300	-0.1313	127	12.600
11	1.000	16.000	-0.1309	235	23.400	-6.400	-0.1313	128	12.700
12	1.100	15.900	-0.1309	236	23.500	-6.500	-0.1314	129	12.800
13	1.200	15.800	-0.1309	237	23.600	-6.600	-0.1314	130	12.900
14	1.300	15.700	-0.1309	238	23.700	-6.700	-0.1313	131	13.000
15	1.400	15.600	-0.1309	239	23.800	-6.800	-0.1314	132	13.100
16	1.500	15.500	-0.1309	240	23.900	-6.900	-0.1314	133	13.200
17	1.600	15.400	-0.1307	241	24.000	-7.000	-0.1314	134	13.300
18	1.700	15.300	-0.1308	242	24.100	-7.100	-0.1314	135	13.400
19	1.800	15.200	-0.1308	243	24.200	-7.200	-0.1314	136	13.500
20	1.900	15.100	-0.1308	244	24.300	-7.300	-0.1314	137	13.600
21	2.000	15.000	-0.1308	245	24.400	-7.400	-0.1314	138	13.700
22	2.100	14.900	-0.1308	246	24.500	-7.500	-0.1314	139	13.800
23	2.200	14.800	-0.1309	247	24.600	-7.600	-0.1314	140	13.900
24	2.300	14.700	-0.1309	248	24.700	-7.700	-0.1314	141	14.000
25	2.400	14.600	-0.1309	249	24.800	-7.800	-0.1314	142	14.100
26	2.500	14.500	-0.1309	250	24.900	-7.900	-0.1314	143	14.200
27	2.600	14.400	-0.1309	251	25.000	-8.000	-0.1314	144	14.300
28	2.700	14.300	-0.1309	252	25.100	-8.100	-0.1315	145	14.400
29	2.800	14.200	-0.1309	253	25.200	-8.200	-0.1314	146	14.500
30	2.900	14.100	-0.1310	254	25.300	-8.300	-0.1315	147	14.600
31	3.000	14.000	-0.1310	255	25.400	-8.400	-0.1315	148	14.700
32	3.100	13.900	-0.1310	256	25.500	-8.500	-0.1315	149	14.800
33	3.200	13.800	-0.1310	257	25.600	-8.600	-0.1315	150	14.900
34	3.300	13.700	-0.1310	258	25.700	-8.700	-0.1315	151	15.000
35	3.400	13.600	-0.1310	259	25.800	-8.800	-0.1315	152	15.100
36	3.500	13.500	-0.1310	260	25.900	-8.900	-0.1315	153	15.200
37	3.600	13.400	-0.1310	261	26.000	-9.000	-0.1315	154	15.300
38	3.700	13.300	-0.1311	262	26.100	-9.100	-0.1315	155	15.400
39	3.800	13.200	-0.1310	263	26.200	-9.200	-0.1315	156	15.500
40	3.900	13.100	-0.1311	264	26.300	-9.300	-0.1315	157	15.600
41	4.000	13.000	-0.1310	265	26.400	-9.400	-0.1315	158	15.700
42	4.100	12.900	-0.1310	266	26.500	-9.500	-0.1315	159	15.800
43	4.200	12.800	-0.1310	267	26.600	-9.600	-0.1315	160	15.900
44	4.300	12.700	-0.1310	268	26.700	-9.700	-0.1315	161	16.000
45	4.400	12.600	-0.1310	269	26.800	-9.800	-0.1315	162	16.100
46	4.500	12.500	-0.1311	270	26.900	-9.900	-0.1315	163	16.200
47	4.600	12.400	-0.1311	271	27.000	-10.000	-0.1315	164	16.300
48	4.700	12.300	-0.1311	272	27.100	-10.100	-0.1316	165	16.400
49	4.800	12.200	-0.1311	273	27.200	-10.200	-0.1315	166	16.500
50	4.900	12.100	-0.1311	274	27.300	-10.300	-0.1315	167	16.600
51	5.000	12.000	-0.1311	275	27.400	-10.400	-0.1315	168	16.700
52	5.100	11.900	-0.1311	276	27.500	-10.500	-0.1315	169	16.800

53	5.200	11.800	-0.1311	277	27.600	-10.600	-0.1315	170	16.900
54	5.300	11.700	-0.1311	278	27.700	-10.700	-0.1315	171	17.000
55	5.400	11.600	-0.1311	279	27.800	-10.800	-0.1315	172	17.100
56	5.500	11.500	-0.1311	280	27.900	-10.900	-0.1315	173	17.200
57	5.600	11.400	-0.1311	281	28.000	-11.000	-0.1315	174	17.300
58	5.700	11.300	-0.1311	282	28.100	-11.100	-0.1315	175	17.400
59	5.800	11.200	-0.1311	283	28.200	-11.200	-0.1315	176	17.500
60	5.900	11.100	-0.1311	284	28.300	-11.300	-0.1315	177	17.600
61	6.000	11.000	-0.1311	285	28.400	-11.400	-0.1315	178	17.700
62	6.100	10.900	-0.1312	286	28.500	-11.500	-0.1315	179	17.800
63	6.200	10.800	-0.1312	287	28.600	-11.600	-0.1315	180	17.900
64	6.300	10.700	-0.1312	288	28.700	-11.700	-0.1315	181	18.000
65	6.400	10.600	-0.1311	289	28.800	-11.800	-0.1315	182	18.100
66	6.500	10.500	-0.1312	290	28.900	-11.900	-0.1315	183	18.200
67	6.600	10.400	-0.1312	291	29.000	-12.000	-0.1315	184	18.300
68	6.700	10.300	-0.1312	292	29.100	-12.100	-0.1315	185	18.400
69	6.800	10.200	-0.1312	293	29.200	-12.200	-0.1315	186	18.500
70	6.900	10.100	-0.1312	294	29.300	-12.300	-0.1315	187	18.600
71	7.000	10.000	-0.1312	295	29.400	-12.400	-0.1315	188	18.700
72	7.100	9.900	-0.1313	296	29.500	-12.500	-0.1315	189	18.800
73	7.200	9.800	-0.1313	297	29.600	-12.600	-0.1314	190	18.900
74	7.300	9.700	-0.1313	298	29.700	-12.700	-0.1314	191	19.000
75	7.400	9.600	-0.1313	299	29.800	-12.800	-0.1314	192	19.100
76	7.500	9.500	-0.1313	300	29.900	-12.900	-0.1314	193	19.200
77	7.600	9.400	-0.1313	301	30.000	-13.000	-0.1314	194	19.300
78	7.700	9.300	-0.1313	302	30.100	-13.100	-0.1314	195	19.400
79	7.800	9.200	-0.1312	303	30.200	-13.200	-0.1314	196	19.500
80	7.900	9.100	-0.1312	304	30.300	-13.300	-0.1314	197	19.600
81	8.000	9.000	-0.1312	305	30.400	-13.400	-0.1314	198	19.700
82	8.100	8.900	-0.1313	306	30.500	-13.500	-0.1314	199	19.800
83	8.200	8.800	-0.1313	307	30.600	-13.600	-0.1314	200	19.900
84	8.300	8.700	-0.1312	308	30.700	-13.700	-0.1314	201	20.000
85	8.400	8.600	-0.1312	309	30.800	-13.800	-0.1314	202	20.100
86	8.500	8.500	-0.1313	310	30.900	-13.900	-0.1314	203	20.200
87	8.600	8.400	-0.1313	311	31.000	-14.000	-0.1314	204	20.300
88	8.700	8.300	-0.1313	312	31.100	-14.100	-0.1314	205	20.400
89	8.800	8.200	-0.1313	313	31.200	-14.200	-0.1314	206	20.500
90	8.900	8.100	-0.1312	314	31.300	-14.300	-0.1314	207	20.600
91	9.000	8.000	-0.1312	315	31.400	-14.400	-0.1314	208	20.700
92	9.100	7.900	-0.1312	316	31.500	-14.500	-0.1314	209	20.800
93	9.200	7.800	-0.1312	317	31.600	-14.600	-0.1314	210	20.900
94	9.300	7.700	-0.1312	318	31.700	-14.700	-0.1314	211	21.000
95	9.400	7.600	-0.1312	319	31.800	-14.800	-0.1314	212	21.100
96	9.500	7.500	-0.1312	320	31.900	-14.900	-0.1314	213	21.200
97	9.600	7.400	-0.1312	321	32.000	-15.000	-0.1314	214	21.300
98	9.700	7.300	-0.1312	322	32.100	-15.100	-0.1314	215	21.400
99	9.800	7.200	-0.1312	323	32.200	-15.200	-0.1314	216	21.500
100	9.900	7.100	-0.1311	324	32.300	-15.300	-0.1314	217	21.600
101	10.000	7.000	-0.1312	325	32.400	-15.400	-0.1314	218	21.700
102	10.100	6.900	-0.1311	326	32.500	-15.500	-0.1314	219	21.800
103	10.200	6.800	-0.1312	327	32.600	-15.600	-0.1314	220	21.900
104	10.300	6.700	-0.1312	328	32.700	-15.700	-0.1314	221	22.000
105	10.400	6.600	-0.1310	329	32.800	-15.800	-0.1314	222	22.100
106	10.500	6.500	-0.1311	330	32.900	-15.900	-0.1314	223	22.200
107	10.600	6.400	-0.1310	331	33.000	-16.000	-0.1314	224	22.300
108	10.700	6.300	-0.1311	332	33.100	-16.100	-0.1315		
109	10.800	6.200	-0.1310	333	33.200	-16.200	-0.1315		
110	10.900	6.100	-0.1310	334	33.300	-16.300	-0.1315		
111	11.000	6.000	-0.1310	335	33.400	-16.400	-0.1316		
112	11.100	5.900	-0.1311	336	33.500	-16.500	-0.1317		

113	11.200	5.800	-0.1311	337	33.600	-16.600	-0.1318
114	11.300	5.700	-0.1311	338	33.700	-16.700	-0.1320
115	11.400	5.600	-0.1311	339	33.800	-16.800	-0.1321
116	11.500	5.500	-0.1305	340	33.900	-16.900	-0.1323
117	11.600	5.400	-0.1286	341	34.000	-17.000	-0.1324

	1st	2nd	3 rd
abs dist.	Run	Run	Run
	Reading	Reading	Reading
mm	Inches	Inches	Inches
5.300	-0.00200		
5.200	-0.00040	-0.00045	
5.100	-0.00010	-0.00045	
5.000	-0.00010	-0.00025	-0.00070
4.900	-0.00015	-0.00020	-0.00070
4.800	-0.00030	-0.00030	-0.00045
4.700	-0.00040	-0.00045	-0.00050
4.600	-0.00055	-0.00065	-0.00050
4.500	-0.00090	-0.00085	-0.00065
4.400	-0.00035	-0.00090	-0.00085
4.300	0.00000	-0.00030	-0.00110
4.200	0.00005	-0.00015	-0.00155
4.100	0.00000	-0.00010	-0.00085
4.000	0.00000	-0.00010	-0.00050
3.900	0.00000	-0.00005	-0.00040
3.800	0.00005	-0.00005	-0.00040
3.700	0.00005	-0.00005	-0.00035
3.600	0.00000	-0.00005	-0.00035
3.500	0.00000	-0.00005	-0.00030
3.400	0.00000	-0.00005	-0.00030
3.300	0.00000	-0.00005	-0.00030
3.200	0.00000	-0.00005	-0.00025
3.100	0.00000	0.00000	-0.00030
3.000	0.00000	-0.00005	-0.00030
2.900	0.00000	-0.00005	-0.00030
2.800	0.00005	-0.00005	-0.00030
2.700	0.00000	-0.00010	-0.00030
2.600	0.00000	-0.00010	-0.00030
2.500	0.00000	-0.00010	-0.00030
2.400	0.00000	-0.00015	-0.00030
2.300	0.00000	-0.00015	-0.00030
2.200	0.00000	-0.00015	-0.00030
2.100	0.00000	-0.00020	-0.00035
2.000	0.00000	-0.00020	-0.00030
1.900	-0.00005	-0.00020	-0.00035
1.800	-0.00005	-0.00020	-0.00035
1.700	-0.00005	-0.00020	-0.00035
1.600	-0.00005	-0.00020	-0.00035
1.500	-0.00020	-0.00020	-0.00035
1.400	-0.00005	-0.00020	-0.00035
1.300	-0.00005	-0.00025	-0.00035
1.200	-0.00005	-0.00025	-0.00035
1.100	-0.00005	-0.00020	-0.00035
1.000	-0.00005	-0.00025	-0.00040
0.900	-0.00005	-0.00025	-0.00040
0.800	-0.00005	-0.00025	-0.00040
0.700	-0.00005	-0.00025	-0.00040
0.600	-0.00010	-0.00020	-0.00040
0.500	-0.00010	-0.00025	-0.00040
0.400	-0.00010	-0.00025	-0.00040
0.300	-0.00010	-0.00025	-0.00040
0.200	-0.00010	-0.00030	-0.00040

0.100	-0.00005	-0.00025	-0.00040
0.000	-0.00010	-0.00035	-0.00040
-0.100	-0.00005	-0.00030	-0.00040
-0.200	-0.00010	-0.00030	-0.00040
-0.300	-0.00010	-0.00035	-0.00045
-0.400	-0.00010	-0.00030	-0.00045
-0.500	-0.00010	-0.00030	-0.00045
-0.600	-0.00010	-0.00030	-0.00045
-0.700	-0.00010	-0.00030	-0.00045
-0.800	-0.00010	-0.00030	-0.00045
-0.900	-0.00010	-0.00035	-0.00040
-1.000	-0.00015	-0.00030	-0.00045
-1.100	-0.00010	-0.00030	-0.00045
-1.200	-0.00010	-0.00035	-0.00045
-1.300	-0.00010	-0.00035	-0.00045
-1.400	-0.00015	-0.00030	-0.00045
-1.500	-0.00015	-0.00035	-0.00045
-1.600	-0.00015	-0.00035	-0.00045
-1.700	-0.00015	-0.00030	-0.00045
-1.800	-0.00015	-0.00030	-0.00040
-1.900	-0.00015	-0.00030	-0.00040
-2.000	-0.00020	-0.00030	-0.00040
-2.100	-0.00015	-0.00035	-0.00040
-2.200	-0.00020	-0.00035	-0.00040
-2.300	-0.00020	-0.00035	-0.00040
-2.400	-0.00020	-0.00035	-0.00040
-2.500	-0.00020	-0.00035	-0.00045
-2.600	-0.00020	-0.00035	-0.00040
-2.700	-0.00020	-0.00035	-0.00045
-2.800	-0.00020	-0.00035	-0.00040
-2.900	-0.00020	-0.00035	-0.00040
-3.000	-0.00020	-0.00035	-0.00045
-3.100	-0.00020	-0.00035	-0.00040
-3.200	-0.00020	-0.00035	-0.00035
-3.300	-0.00025	-0.00035	-0.00030
-3.400	-0.00025	-0.00035	-0.00025
-3.500	-0.00025	-0.00030	-0.00030
-3.600	-0.00025	-0.00025	-0.00030
-3.700	-0.00025	-0.00020	-0.00040
-3.800	-0.00015	-0.00020	-0.00065
-3.900	-0.00010	-0.00020	-0.00065
-4.000	-0.00010	-0.00030	-0.00090
-4.100	-0.00010	-0.00050	-0.00110
-4.200	-0.00020	-0.00055	-0.00080
-4.300	-0.00040	-0.00080	-0.00075
-4.400	-0.00050	-0.00085	-0.00075
-4.500	-0.00080	-0.00060	-0.00075
-4.600	-0.00075	-0.00055	-0.00080
-4.700	-0.00055	-0.00060	-0.00100
-4.800	-0.00045	-0.00060	-0.00110
-4.900	-0.00045	-0.00080	
-5.000	-0.00055	-0.00105	
-5.100	-0.00070	-0.00100	
-5.200	-0.00080		
-5.300	-0.00310		0.00000

off the cap

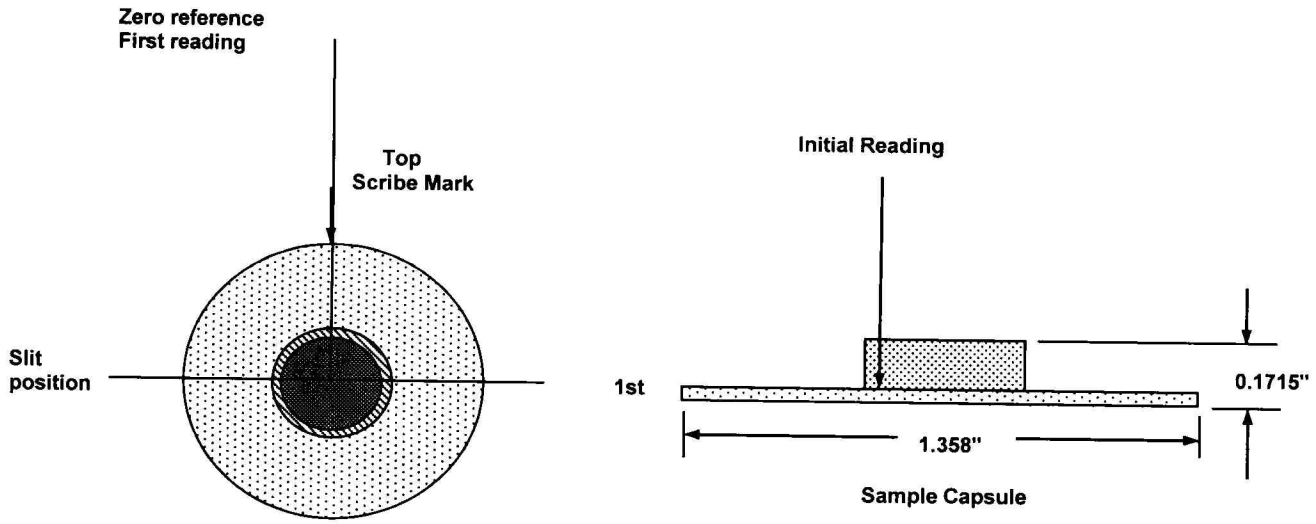
-0.00275

redo

SAMPLE CAPSULE: **5** 6/7/2010
SAMPLE MATERIAL: **Molybdenum**

4.704
4.703

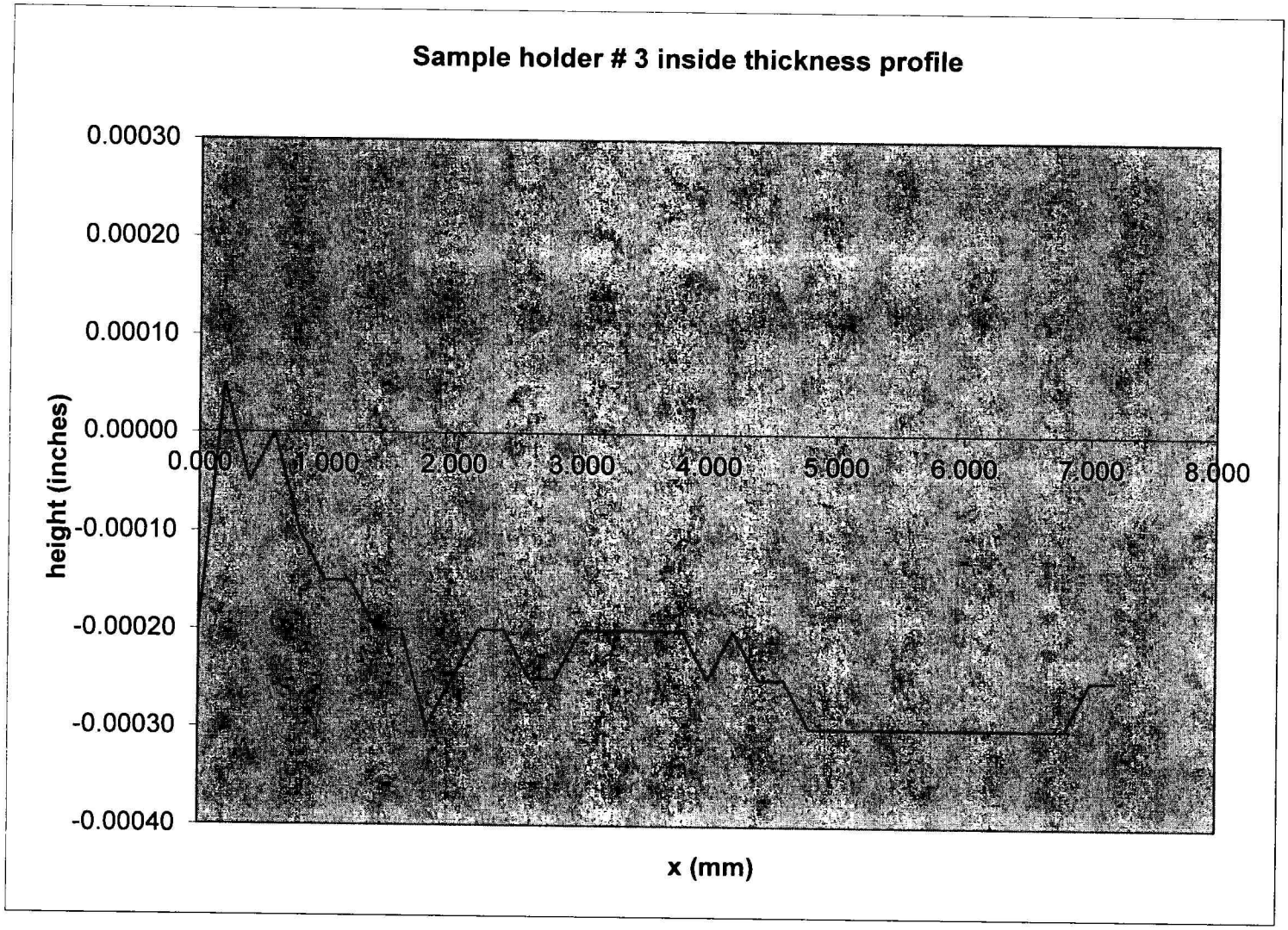
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER # 3



1.338582677

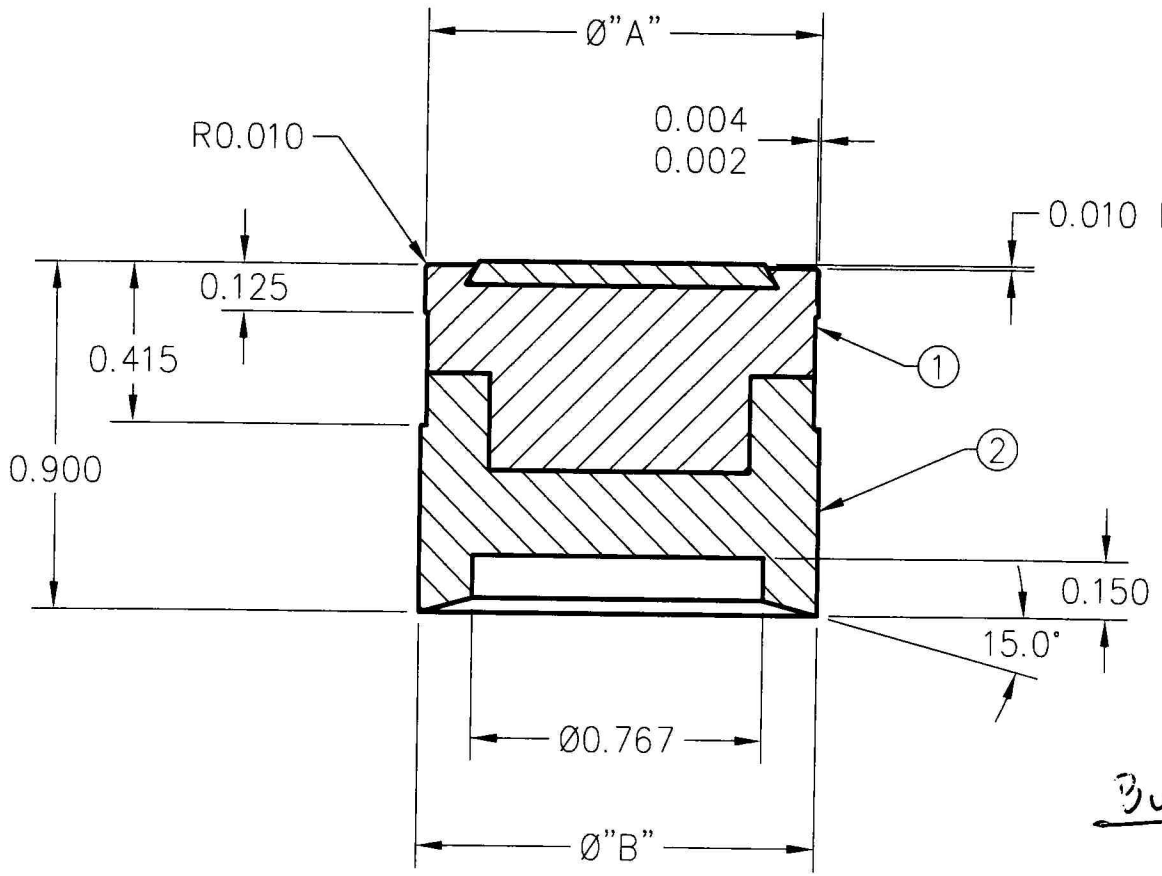
Average thickness reading = -0.00023

Note: The thickness of the reference zero point from the base is = 0.04160 Inches
1.05664 mm


Sample holder # 3 inside thickness profile
0.00030
0.00020
0.00010
0.00000
-0.00010
-0.00020
-0.00030
-0.00040
height (inches)
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	-0.00020	3.508	south
2	0.200	0.00005	3.30800	
3	0.400	-0.00005	3.10800	
4	0.600	0.00000	2.90800	
5	0.800	-0.00010	2.70800	
6	1.000	-0.00015	2.50800	
7	1.200	-0.00015	2.30800	
8	1.400	-0.00020	2.10800	
9	1.600	-0.00020	1.90800	
10	1.800	-0.00030	1.70800	
11	2.000	-0.00025	1.50800	
12	2.200	-0.00020	1.30800	
13	2.400	-0.00020	1.10800	
14	2.600	-0.00025	0.90800	
15	2.800	-0.00025	0.70800	
16	3.000	-0.00020	0.50800	
17	3.200	-0.00020	0.30800	
18	3.400	-0.00020	0.10800	
19	3.600	-0.00020	-0.09200	
20	3.800	-0.00020	-0.29200	
21	4.000	-0.00025	-0.49200	
22	4.200	-0.00020	-0.69200	
23	4.400	-0.00025	-0.89200	
24	4.600	-0.00025	-1.09200	
25	4.800	-0.00030	-1.29200	
26	5.000	-0.00030	-1.49200	
27	5.200	-0.00030	-1.69200	
28	5.400	-0.00030	-1.89200	
29	5.600	-0.00030	-2.09200	
30	5.800	-0.00030	-2.29200	
31	6.000	-0.00030	-2.49200	
32	6.200	-0.00030	-2.69200	
33	6.400	-0.00030	-2.89200	
34	6.600	-0.00030	-3.09200	
35	6.800	-0.00030	-3.29200	
36	7.000	-0.00025	-3.49200	
37	7.200	-0.00025	-3.69200	north



Note: Super Glue & Press Fit 1 & 2

Al 0.0973 9/9/10

BUILT AS
0.9806
0.9906

SHOT# 413		
A	0.9800	+.0000 −.0005
B	0.9900	+.0005 −.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-048	1
1	Sabot & Flyer Plate	LGG-049	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

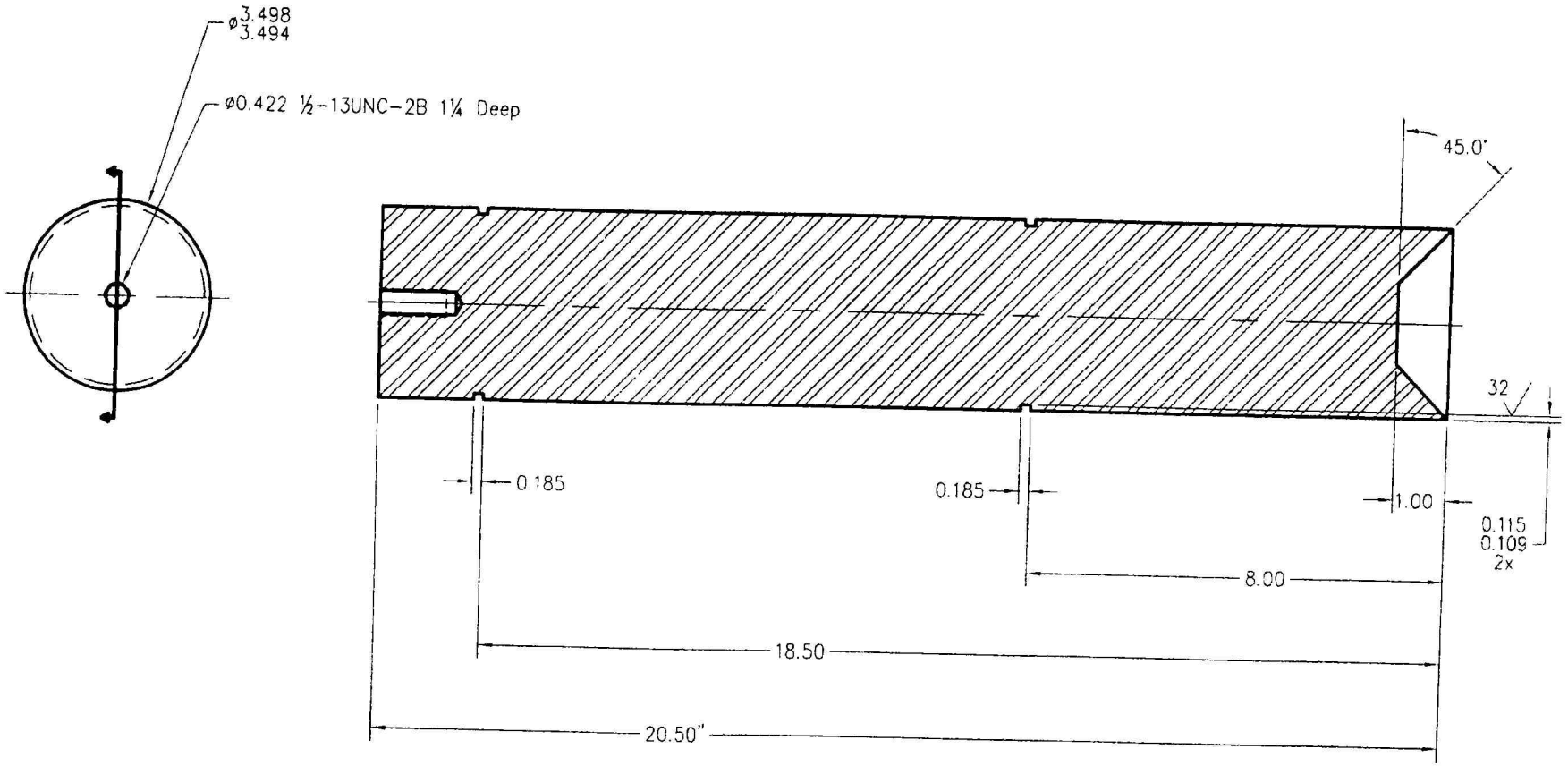
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long DATE 1/23/04
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE
Projectile Assy.

FINISH 16
MATERIAL Zelux-M&HDP
SCALE 2:1
SHEET 2 of 2
A
DRAWING NUMBER LGG-050



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES: .000 ±.005, .00 ±.01, FRACTIONS ±1/64, ANGLES ±1/2, CONCENTRICITY .005 T.I.R. BREAK SHARP EDGES AND REMOVE BURRS	DRAWN M. Long	DATE 10/04/01	CALIFORNIA INSTITUTE of TECHNOLOGY SHOCK WAVE LABORATORY
	ENGINEER	DATE	TITLE PISTON -1 Piece
	APPROVED	DATE	
FINISH 63	MATERIAL H.D. POLY	SCALE 1:2	SHEET 1 of 1
			B
			DRAWING NUMBER LGG-029

Shot 413 Nominal Timeline Preshot

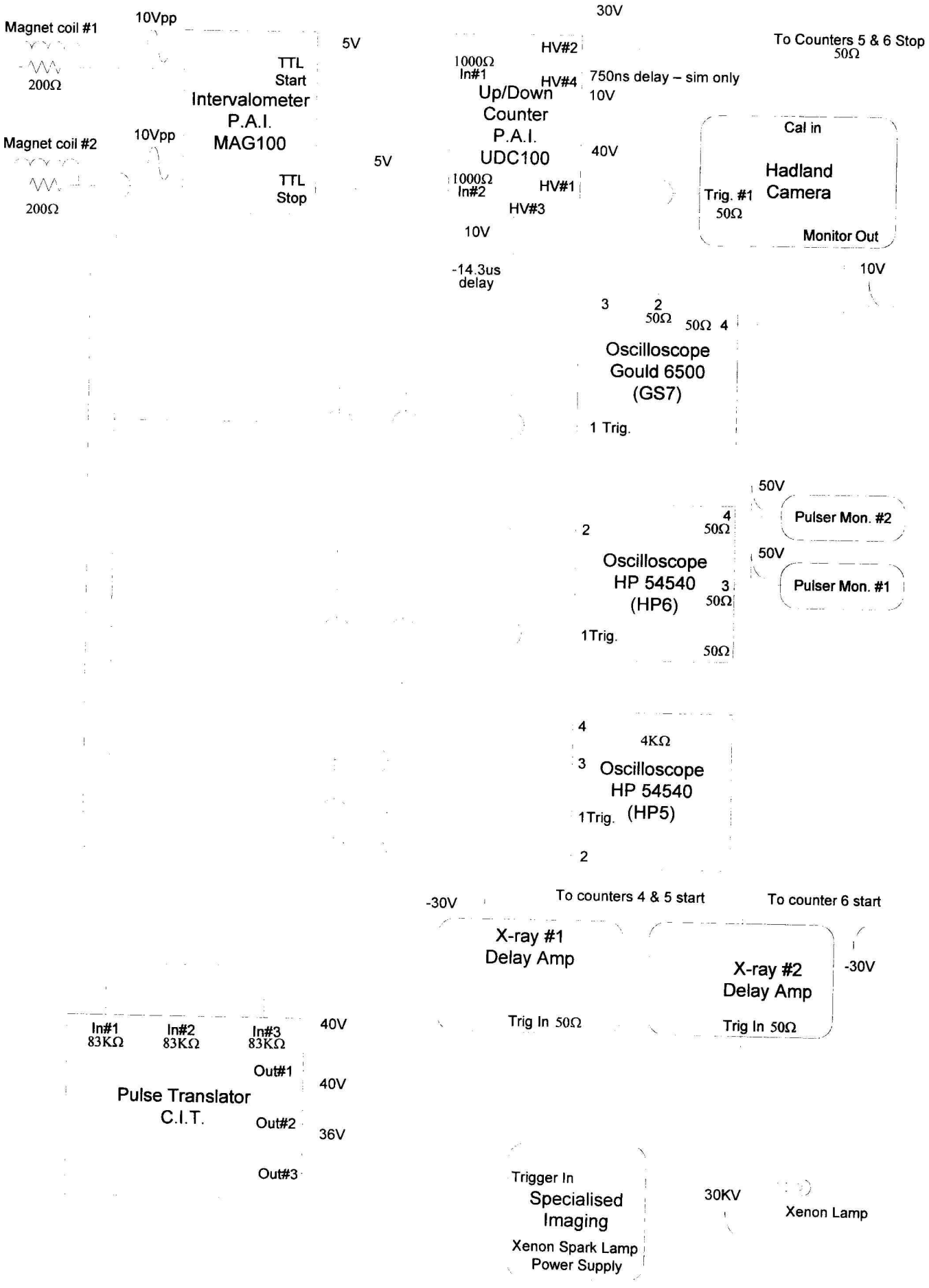
V	4500				
cable time	90	150			
tervalometer intrinsic delay	[redacted]				
UDC extra count lag	[redacted]				
pulse translator delay	150				
X-ray 1 program delay	[redacted]	3570	X-ray 1 actual delay	M1-fid1 distance	0.03
X-ray 2 program delay	[redacted]	82490	X-ray 2 actual delay	M1-fid2 distance	0.383145
X-ray 1 pulser delay	600			Flyer thickness	0.002472
X-ray 2 pulser delay	[redacted]				
Camera intrinsic delay	107			Us(Mo)	6599.37406
Streak duration	1514			driver thickness	0.001051
d dead streak before driver	500			estimated sample+cover time	566

M1-M2 distance 0.203606
M2-target distance 0.211785
M2-target fudge [redacted]

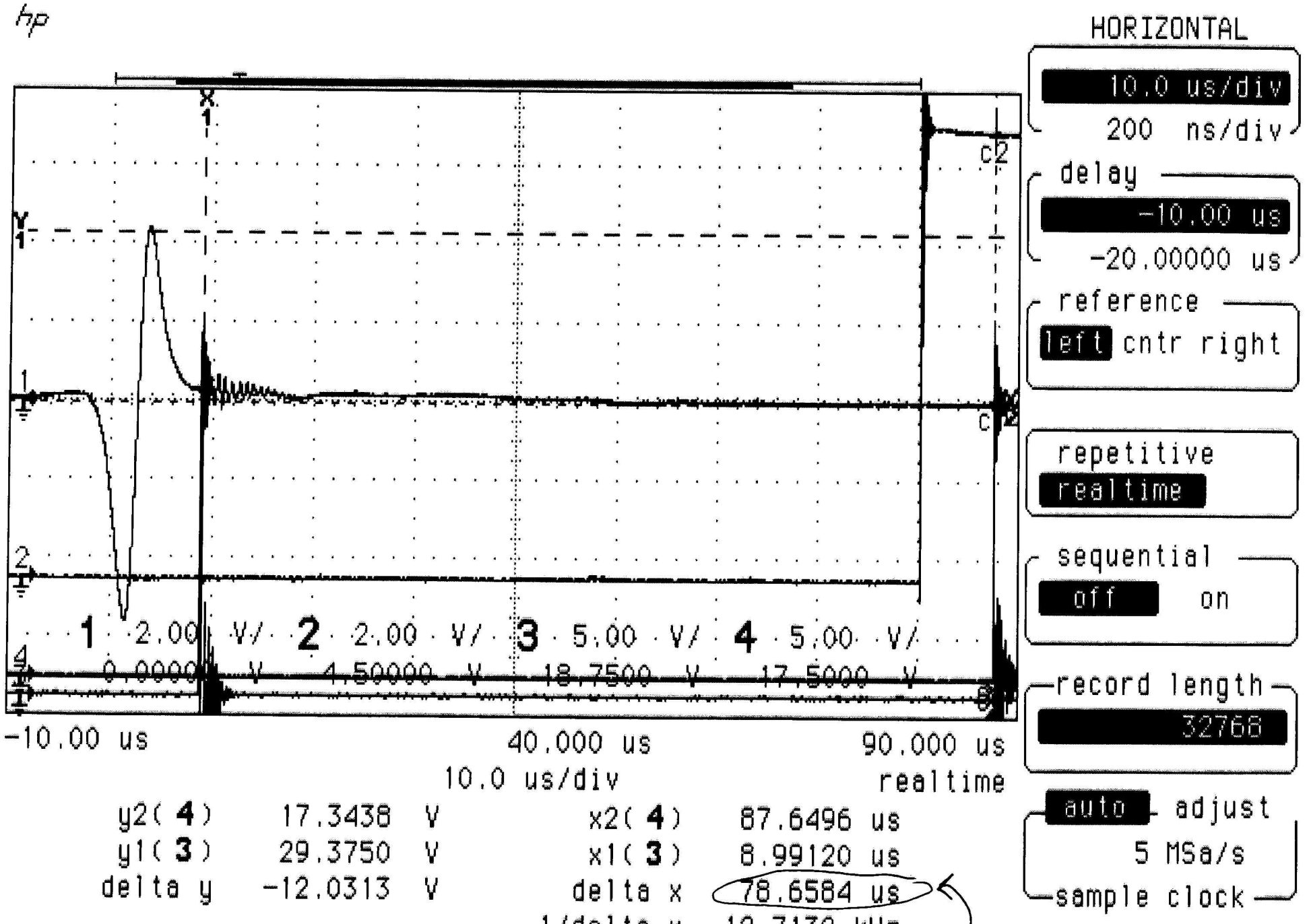
t (ns)	flyer x (m)	shock front (m)	event
0	0.001236		M1 zero-crossing
150	0.001911		HP5-1, GS7-1, Intervalometer start
2230	0.011271		HP5-3, UDC start, signal to pulse translator
2380	0.011946		pulse translator out, GS7 trig
5950	0.028011		X-ray 1 delay amp out to counters 4, 5
6640	0.031116		X-ray 1 fires
6730	0.031521		X-ray 1 pulse monitor at counter 4b
45246	0.204842		M2 zero-crossing
45396	0.205517		HP5-2, Intervalometer stop
47476	0.214877		HP5-4, UDC stop
84870	0.383151		X-ray 2 delay amp, stop counter 4, start counter 6
85585	0.3863685		X-ray 2 fires
85675	0.3867735		X-ray 2 pulse monitor at counter 4b
91497	0.41297116		UDC out, GS7-3, stop counters 5 and 6
91587	0.41337616		Trigger at camera
91694	0.41385766		Begin Streak
91784	0.41426266		Camera Monitor on GS7-4
92034	0.415391	0	IMPACT
92194		0.001051	Driver arrival on streak
92760		0.004786246	Sample cutoff on streak
93208		0.007742765	End Streak

				X-ray velocity	4500
					On film
			X-ray 1 flyer vs. fid (mm)	1.116	1.29767442
Counter 3:	45246				
				HP5 2-1	45246
UDC upcount:	45246			HP5 4-3	45246
Counter 4:	78920				
			X-ray 2 flyer vs. fid (mm)	3.2235	3.74825581
Counter 4b:	78945				
Counter 5:	85547			GS7 3-1	91347
Counter 6:	6627			GS7 4-1	91634
Driver cutoff on streak	500				
Sample cutoff on sreak	1066				

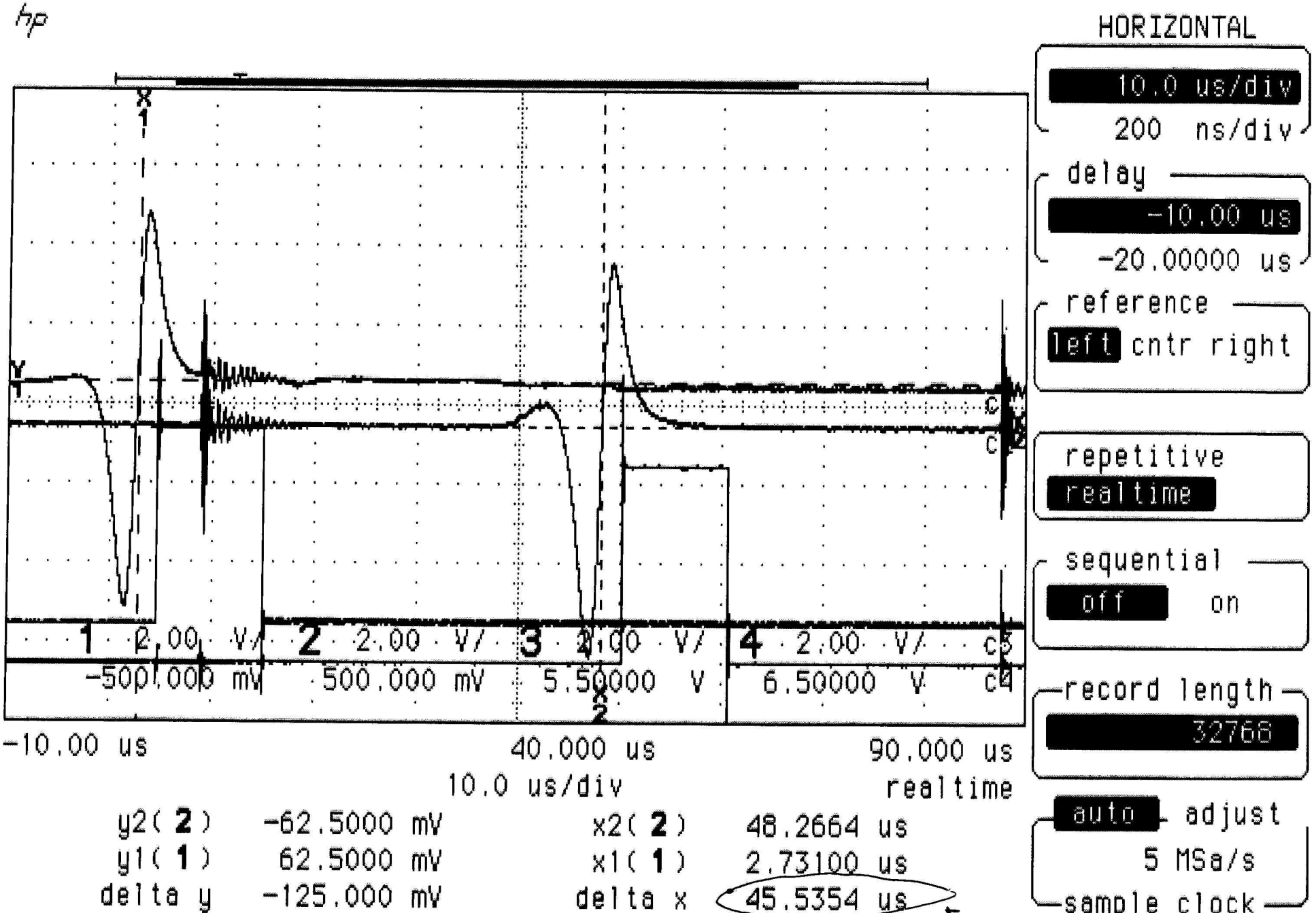
Shot #413 Scope Schematic



HP6 LCG Shot 43

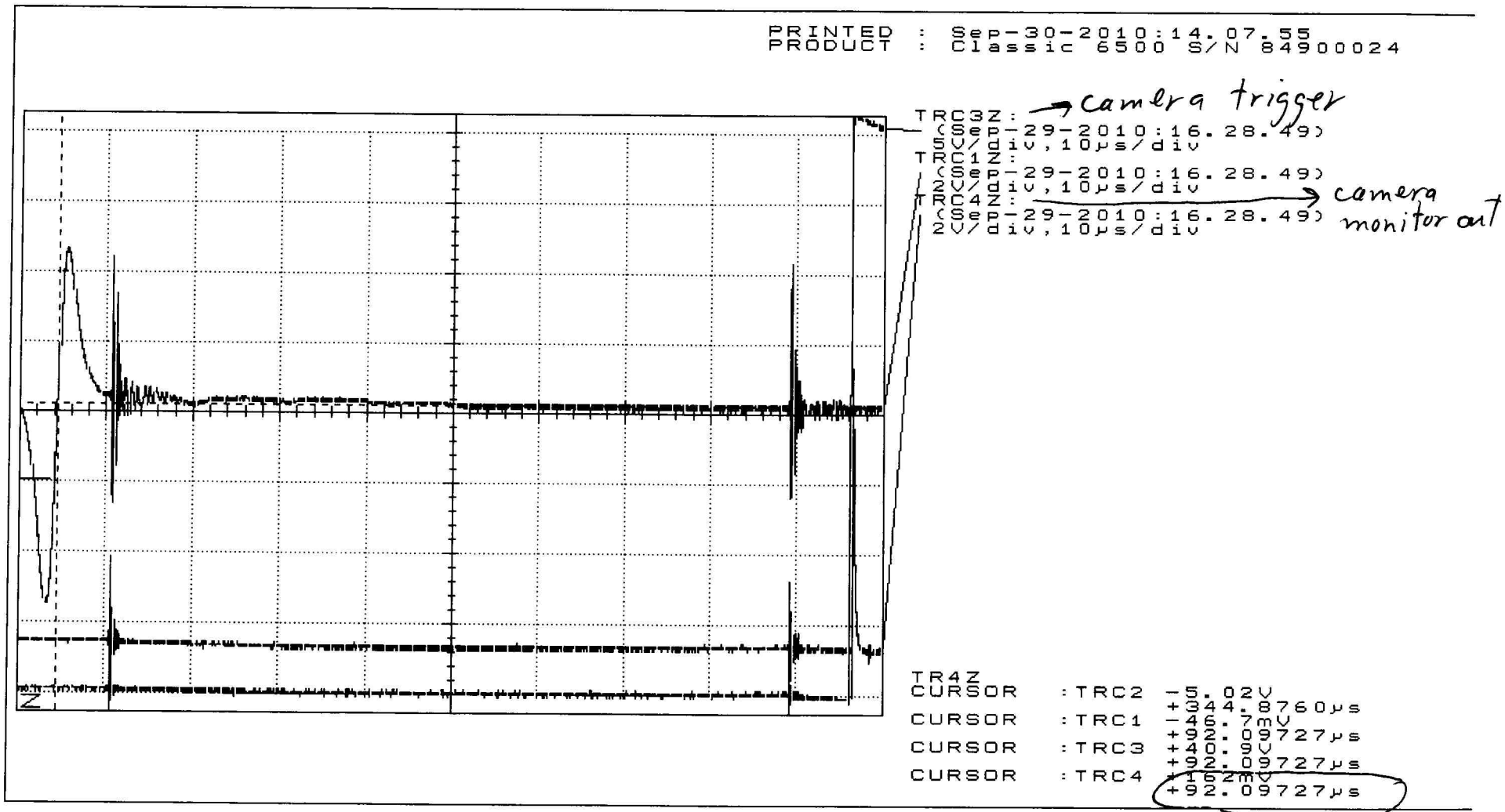


HPS LGG Shot 413



Velocity magnet 1 to 2 interval

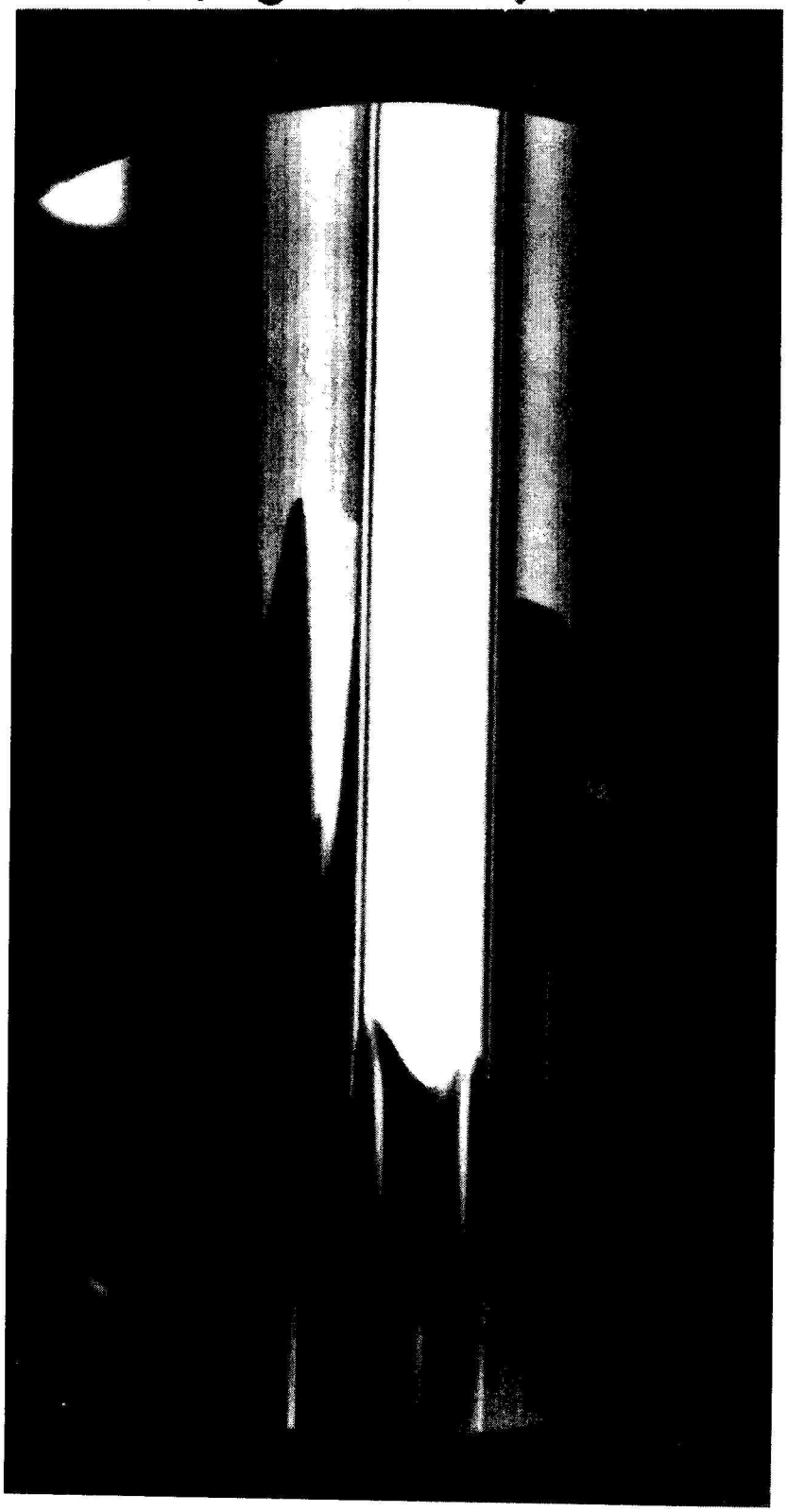
GS7 Shot 413



Magnet 1 to camer monitor cut interval ↑

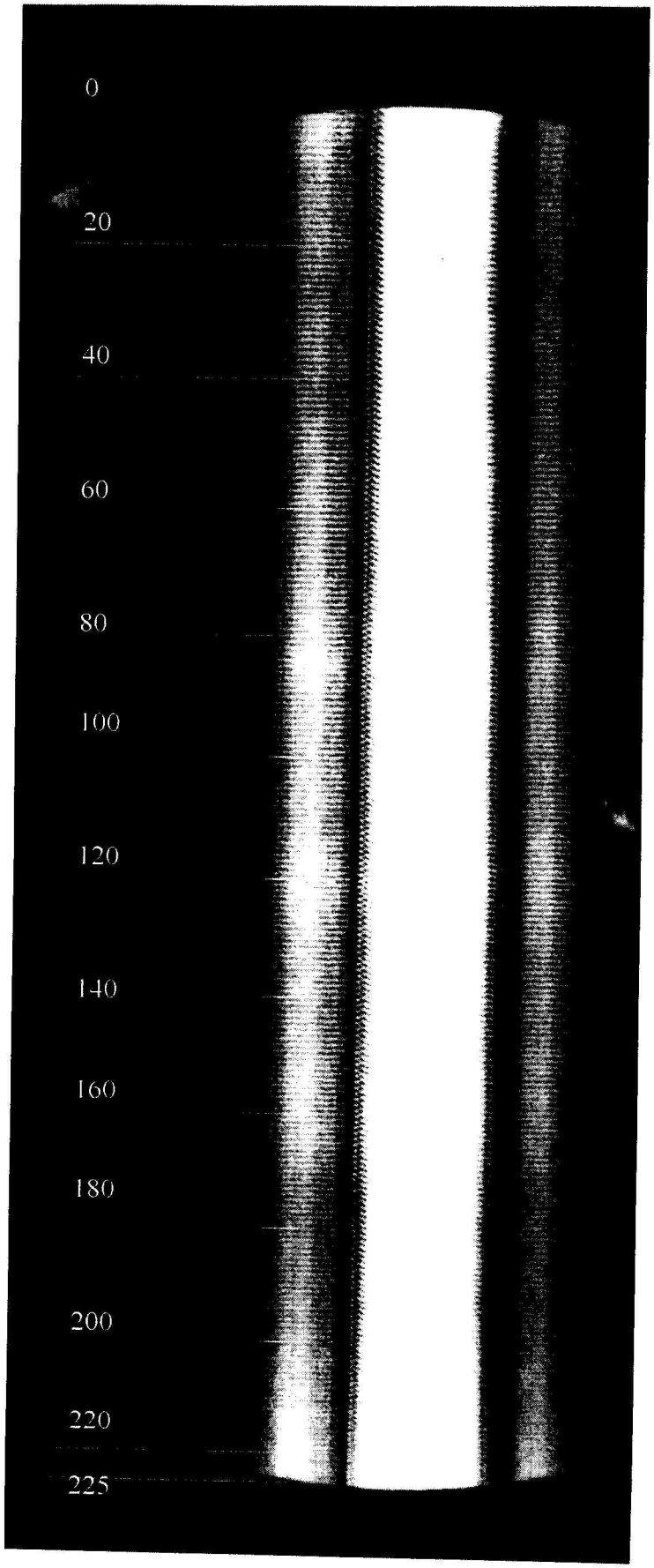
camera trigger to monitorcut = 283 ns

413 shot



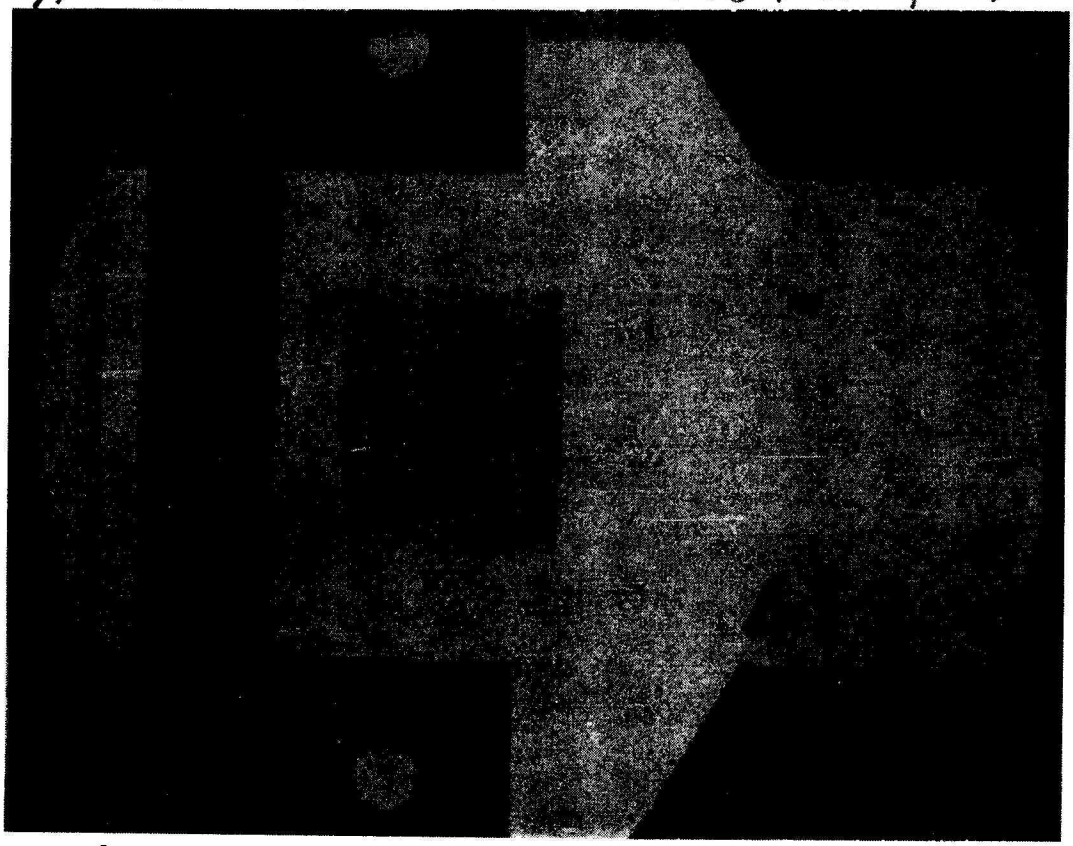
413 shot

413 Cal.

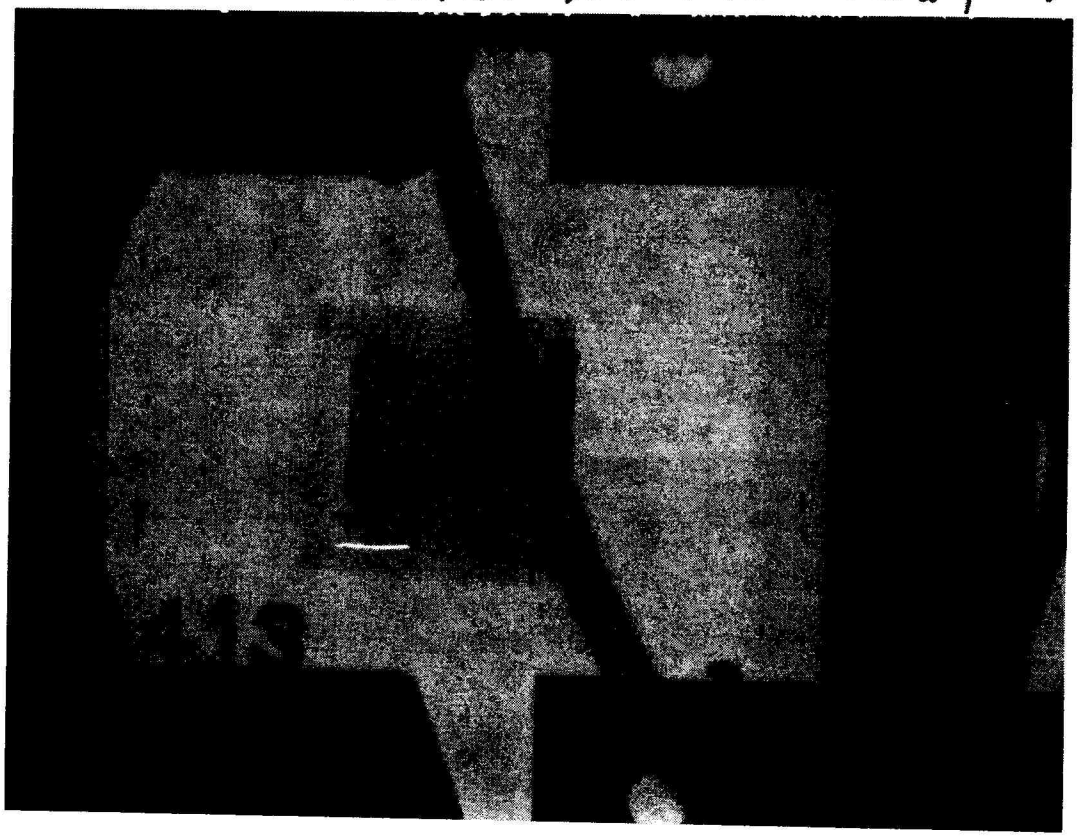


6.757ns × 225 =
1520ns

9/29/10 LGG Shot 413 Flash Xray #1



9/29/10 LGGshot 413 Flash Xray #2



LIGHT GAS GUN DATA SHEET

Shot No. 414 Date 10/13/10

Target:

Sample Material Hedenbergite Crystallographic orientation —

Source Location Univ. of Michigan Thickness: 1 _____ in.

Type of Measurement _____ 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height — in. Driver Plate Thickness _____ in.
(shim to driver) Material _____

Projectile:

Weight 18.034 gms. Length 0.8980 in. Skirt Diameter 0.9900 in.

Flyer Plate Material Ta Leading Edge Dia. 0.9795 in.

Thickness 0.0611 in. Major Dia. 0.8138 in. Depth Inserted 2 in.

Minor Dia. 0.75 in. Force 60 lbs

Barrel Dimensions:

Breech Diameter 0.9873 in. Muzzle Diameter 0.980 in. Taper 0.0073 in.

Ellipticity @ projectile depth insertion point 0.0005 in.

Piston:

Weight 6.61 lb. Length 20.5 in. O-ring Groove Depth 0.109 in.

Diameter: Front 3.497 in. Back 3.499 in.

Pump Tube:

Pre-Fill Pressure -29 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 738 gms. Type IMR 4350 Total Charge 750 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 6.2 km/sec Piston 0.71 km/sec

Notes: Temp at shot time: 1402°C @ 7:30 total heating time

L.G.G.

1527

Camera Streak Duration: 1500 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.85

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 1.74 µsec Flash X-ray #2 59.15 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0552 in. min.	0.0933 in. min.
0.0563 in. max.	0.0939 in. max

Expected Burst Pressure 4K psi

Instrument Tank/Vacuum Pump Pressure: 60 16/68 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.68 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.717 km/sec

Piston Velocity from Gauge #1 to #3: 0.720 km/sec

Projectile Velocity from UDC: 6199.4 m/sec

Projectile Velocity from X-ray: _____ km/sec

6181

L.G.G. Shot 414

COUNTER CONNECTIONS

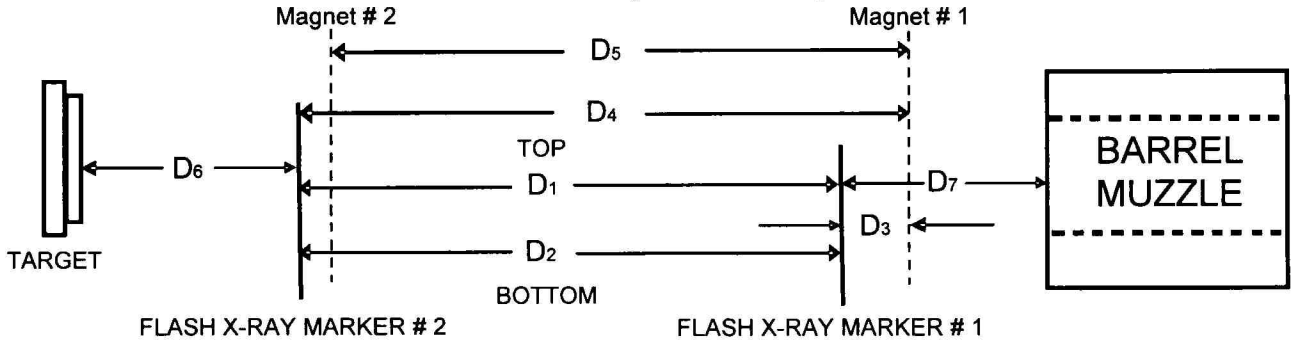
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	425 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	847 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	32.8 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	57.240 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	62.604 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	5.367 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	57.211 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	32.84 ~~6199.~~ µsec
UDC Velocity:			6199.4 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 ×1 1.964	Velocity magnet 2 ×2 34.800	32.836 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start ×3 4.036	2.072 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop ×4 36.863	2.063 µsec
HP6, 1-2:	Velocity Magnet 1 ×1 1.997	Xenon Lamp Trigger ×2 54.262	52.295 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out ×3 6.3874	X-ray 2 Pulser Monitor Out ×4 63.598	57.211 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	66.610 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	66.896 µsec

TARGET MEASUREMENT

Shot No. **414** Expected Velocity: **6.20** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	36.5	99.0
Measure # 2, mm	30.00	383.15	203.66	37.0	99.0
Average, mm	30.00	383.15	203.61	36.8	99.0
Travel time, µsec	**4.84**	**61.80**	**32.84**	**5.93**	**15.97**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **56.97** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **56.95** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **1.74** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **59.15** µsec.

MAGNET DISTANCE

Shot No. **414** Expected Velocity: **6.20**

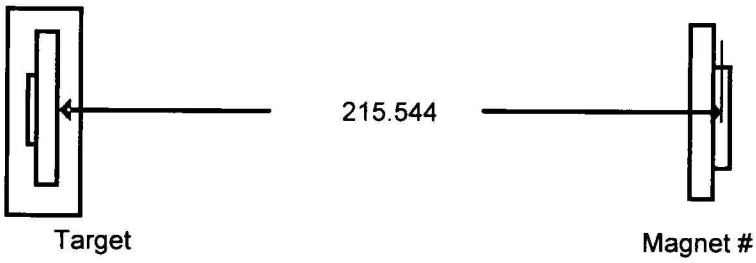
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **32.840 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.360 inch

Second measurement = 8.362 inch

Average measurement = 8.361 inch

Average measurement = 212.369 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 215.544 mm

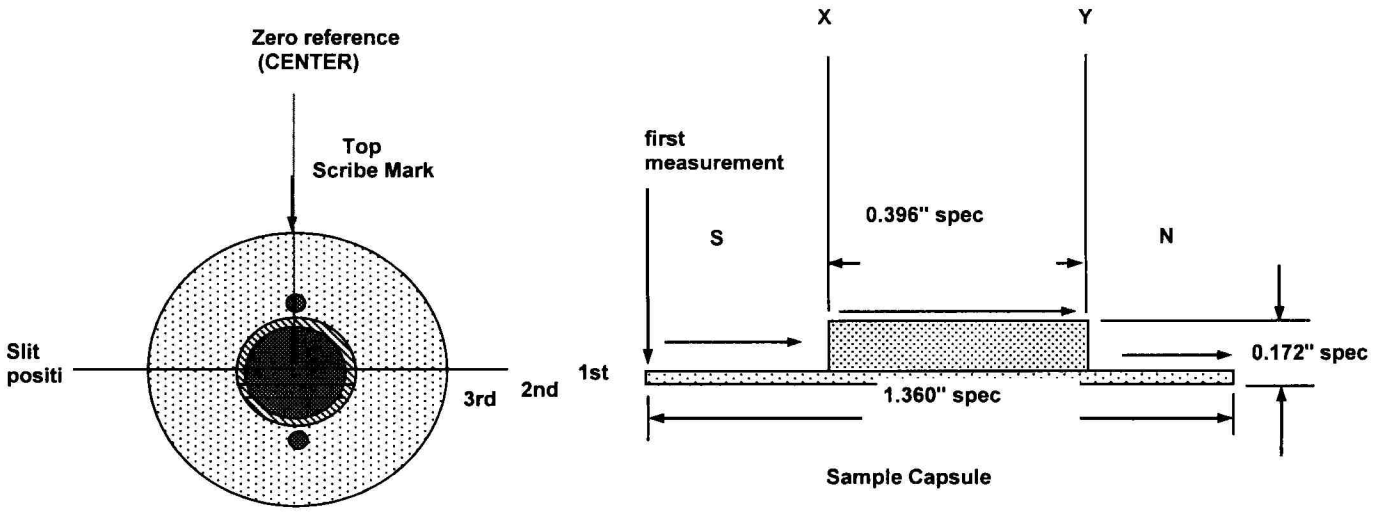
TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **34.765 µsec.**

Fudged Distance between Magnet 2 to Target = ~~0 mm~~ ~~0.196749m~~ 0.196025 m

SHOT No. ____414_____ tip used: .7mm long/ flat tip
SAMPLE CAPSULE: ____6_____ note: the platform on which the measurement was taken
SAMPLE MATERIAL: Hedenbergite deviates from flat by +0.013 max.
direction of measurement

5.194
5.17

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = -0.00023

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = -0.00046

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = -0.00059

Note: Measurement from reference zero point from the base is = 0.1763 Inches
4.4787 mm

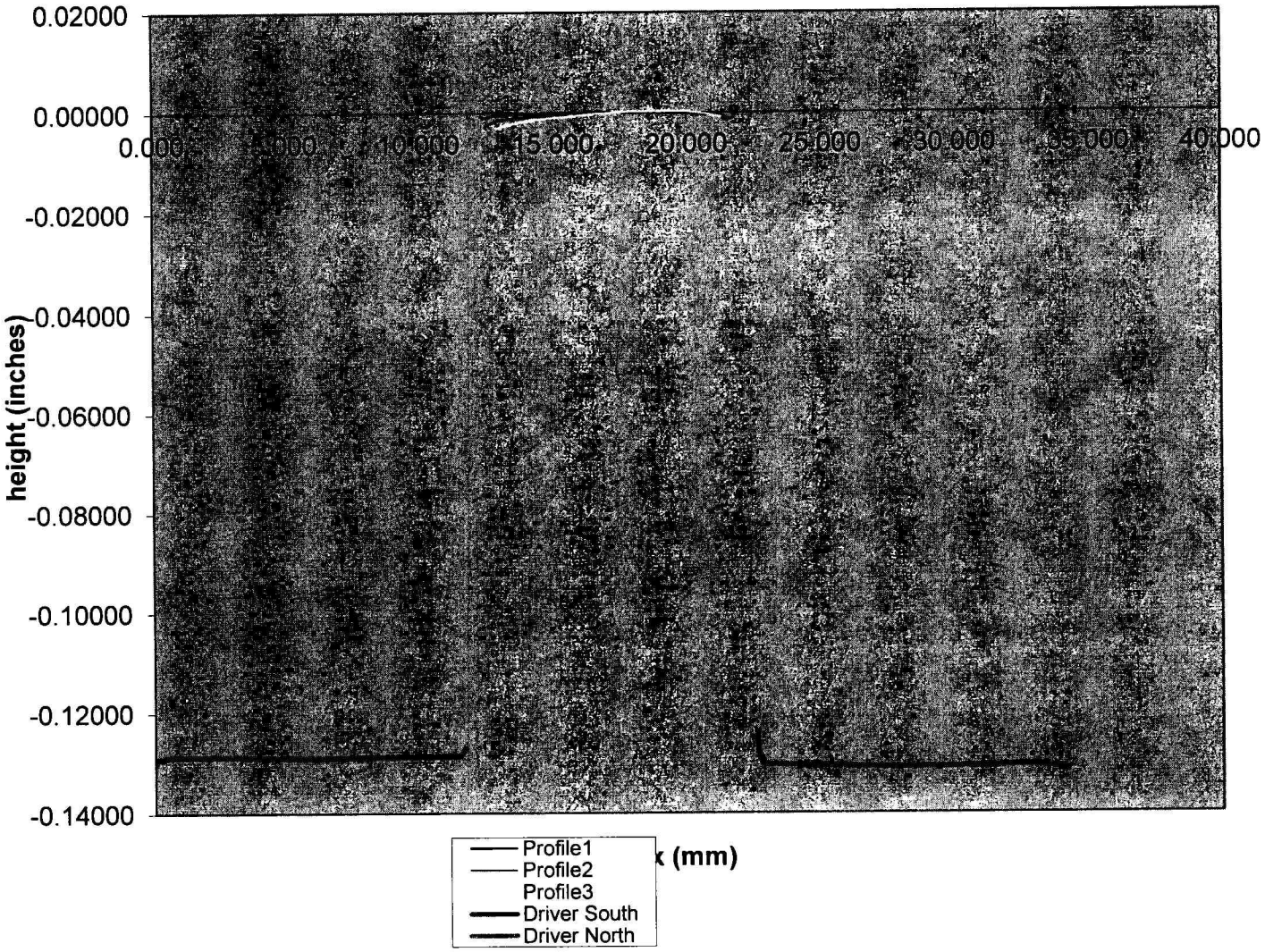
Average thickness of the driver Plate = 0.0467 Inches
1.1866 mm

Thickness of the Carbon Deposited on the coil side is = 89.5 **nm**

Thickness of the Carbon Deposited on the Projectile side is = 97.4 **nm**

Distance from the top of the cap to the measured (avg) driver plate **0.13** Inches
3.29 mm

Shot # 414 Cap thickness profile Polish



1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading	Reading Distance mm
1	0.000	17.000	-0.1303	225	22.400	-5.400	-0.1250	118	11.700
2	0.100	16.900	-0.1292	226	22.500	-5.500	-0.1250	119	11.800
3	0.200	16.800	-0.1291	227	22.600	-5.600	-0.1280	120	11.900
4	0.300	16.700	-0.1290	228	22.700	-5.700	-0.1301	121	12.000
5	0.400	16.600	-0.1289	229	22.800	-5.800	-0.1303	122	12.100
6	0.500	16.500	-0.1288	230	22.900	-5.900	-0.1303	123	12.200
7	0.600	16.400	-0.1287	231	23.000	-6.000	-0.1303	124	12.300
8	0.700	16.300	-0.1287	232	23.100	-6.100	-0.1303	125	12.400
9	0.800	16.200	-0.1287	233	23.200	-6.200	-0.1303	126	12.500
10	0.900	16.100	-0.1287	234	23.300	-6.300	-0.1303	127	12.600
11	1.000	16.000	-0.1286	235	23.400	-6.400	-0.1303	128	12.700
12	1.100	15.900	-0.1286	236	23.500	-6.500	-0.1303	129	12.800
13	1.200	15.800	-0.1286	237	23.600	-6.600	-0.1303	130	12.900
14	1.300	15.700	-0.1287	238	23.700	-6.700	-0.1303	131	13.000
15	1.400	15.600	-0.1286	239	23.800	-6.800	-0.1304	132	13.100
16	1.500	15.500	-0.1286	240	23.900	-6.900	-0.1303	133	13.200
17	1.600	15.400	-0.1286	241	24.000	-7.000	-0.1304	134	13.300
18	1.700	15.300	-0.1286	242	24.100	-7.100	-0.1304	135	13.400
19	1.800	15.200	-0.1287	243	24.200	-7.200	-0.1304	136	13.500
20	1.900	15.100	-0.1287	244	24.300	-7.300	-0.1304	137	13.600
21	2.000	15.000	-0.1286	245	24.400	-7.400	-0.1304	138	13.700
22	2.100	14.900	-0.1286	246	24.500	-7.500	-0.1305	139	13.800
23	2.200	14.800	-0.1286	247	24.600	-7.600	-0.1304	140	13.900
24	2.300	14.700	-0.1286	248	24.700	-7.700	-0.1305	141	14.000
25	2.400	14.600	-0.1287	249	24.800	-7.800	-0.1305	142	14.100
26	2.500	14.500	-0.1286	250	24.900	-7.900	-0.1305	143	14.200
27	2.600	14.400	-0.1286	251	25.000	-8.000	-0.1305	144	14.300
28	2.700	14.300	-0.1287	252	25.100	-8.100	-0.1305	145	14.400
29	2.800	14.200	-0.1287	253	25.200	-8.200	-0.1305	146	14.500
30	2.900	14.100	-0.1287	254	25.300	-8.300	-0.1306	147	14.600
31	3.000	14.000	-0.1287	255	25.400	-8.400	-0.1306	148	14.700
32	3.100	13.900	-0.1285	256	25.500	-8.500	-0.1305	149	14.800
33	3.200	13.800	-0.1286	257	25.600	-8.600	-0.1306	150	14.900
34	3.300	13.700	-0.1287	258	25.700	-8.700	-0.1306	151	15.000
35	3.400	13.600	-0.1287	259	25.800	-8.800	-0.1306	152	15.100
36	3.500	13.500	-0.1287	260	25.900	-8.900	-0.1306	153	15.200
37	3.600	13.400	-0.1287	261	26.000	-9.000	-0.1306	154	15.300
38	3.700	13.300	-0.1288	262	26.100	-9.100	-0.1306	155	15.400
39	3.800	13.200	-0.1287	263	26.200	-9.200	-0.1307	156	15.500
40	3.900	13.100	-0.1288	264	26.300	-9.300	-0.1307	157	15.600
41	4.000	13.000	-0.1288	265	26.400	-9.400	-0.1307	158	15.700
42	4.100	12.900	-0.1288	266	26.500	-9.500	-0.1307	159	15.800
43	4.200	12.800	-0.1288	267	26.600	-9.600	-0.1307	160	15.900
44	4.300	12.700	-0.1288	268	26.700	-9.700	-0.1307	161	16.000
45	4.400	12.600	-0.1288	269	26.800	-9.800	-0.1307	162	16.100
46	4.500	12.500	-0.1289	270	26.900	-9.900	-0.1307	163	16.200
47	4.600	12.400	-0.1288	271	27.000	-10.000	-0.1308	164	16.300
48	4.700	12.300	-0.1288	272	27.100	-10.100	-0.1307	165	16.400
49	4.800	12.200	-0.1289	273	27.200	-10.200	-0.1308	166	16.500
50	4.900	12.100	-0.1289	274	27.300	-10.300	-0.1308	167	16.600
51	5.000	12.000	-0.1289	275	27.400	-10.400	-0.1308	168	16.700
52	5.100	11.900	-0.1289	276	27.500	-10.500	-0.1308	169	16.800

53	5.200	11.800	-0.1289	277	27.600	-10.600	-0.1308	170	16.900
54	5.300	11.700	-0.1289	278	27.700	-10.700	-0.1308	171	17.000
55	5.400	11.600	-0.1289	279	27.800	-10.800	-0.1308	172	17.100
56	5.500	11.500	-0.1289	280	27.900	-10.900	-0.1308	173	17.200
57	5.600	11.400	-0.1289	281	28.000	-11.000	-0.1307	174	17.300
58	5.700	11.300	-0.1289	282	28.100	-11.100	-0.1308	175	17.400
59	5.800	11.200	-0.1289	283	28.200	-11.200	-0.1308	176	17.500
60	5.900	11.100	-0.1289	284	28.300	-11.300	-0.1308	177	17.600
61	6.000	11.000	-0.1289	285	28.400	-11.400	-0.1308	178	17.700
62	6.100	10.900	-0.1289	286	28.500	-11.500	-0.1308	179	17.800
63	6.200	10.800	-0.1289	287	28.600	-11.600	-0.1308	180	17.900
64	6.300	10.700	-0.1289	288	28.700	-11.700	-0.1308	181	18.000
65	6.400	10.600	-0.1289	289	28.800	-11.800	-0.1307	182	18.100
66	6.500	10.500	-0.1289	290	28.900	-11.900	-0.1308	183	18.200
67	6.600	10.400	-0.1289	291	29.000	-12.000	-0.1307	184	18.300
68	6.700	10.300	-0.1289	292	29.100	-12.100	-0.1307	185	18.400
69	6.800	10.200	-0.1289	293	29.200	-12.200	-0.1307	186	18.500
70	6.900	10.100	-0.1289	294	29.300	-12.300	-0.1307	187	18.600
71	7.000	10.000	-0.1289	295	29.400	-12.400	-0.1307	188	18.700
72	7.100	9.900	-0.1289	296	29.500	-12.500	-0.1307	189	18.800
73	7.200	9.800	-0.1288	297	29.600	-12.600	-0.1307	190	18.900
74	7.300	9.700	-0.1288	298	29.700	-12.700	-0.1308	191	19.000
75	7.400	9.600	-0.1288	299	29.800	-12.800	-0.1307	192	19.100
76	7.500	9.500	-0.1288	300	29.900	-12.900	-0.1308	193	19.200
77	7.600	9.400	-0.1288	301	30.000	-13.000	-0.1307	194	19.300
78	7.700	9.300	-0.1288	302	30.100	-13.100	-0.1307	195	19.400
79	7.800	9.200	-0.1289	303	30.200	-13.200	-0.1307	196	19.500
80	7.900	9.100	-0.1288	304	30.300	-13.300	-0.1306	197	19.600
81	8.000	9.000	-0.1288	305	30.400	-13.400	-0.1307	198	19.700
82	8.100	8.900	-0.1288	306	30.500	-13.500	-0.1306	199	19.800
83	8.200	8.800	-0.1288	307	30.600	-13.600	-0.1306	200	19.900
84	8.300	8.700	-0.1287	308	30.700	-13.700	-0.1306	201	20.000
85	8.400	8.600	-0.1287	309	30.800	-13.800	-0.1306	202	20.100
86	8.500	8.500	-0.1287	310	30.900	-13.900	-0.1306	203	20.200
87	8.600	8.400	-0.1287	311	31.000	-14.000	-0.1306	204	20.300
88	8.700	8.300	-0.1287	312	31.100	-14.100	-0.1306	205	20.400
89	8.800	8.200	-0.1287	313	31.200	-14.200	-0.1306	206	20.500
90	8.900	8.100	-0.1287	314	31.300	-14.300	-0.1305	207	20.600
91	9.000	8.000	-0.1287	315	31.400	-14.400	-0.1306	208	20.700
92	9.100	7.900	-0.1287	316	31.500	-14.500	-0.1305	209	20.800
93	9.200	7.800	-0.1287	317	31.600	-14.600	-0.1305	210	20.900
94	9.300	7.700	-0.1287	318	31.700	-14.700	-0.1305	211	21.000
95	9.400	7.600	-0.1287	319	31.800	-14.800	-0.1305	212	21.100
96	9.500	7.500	-0.1287	320	31.900	-14.900	-0.1305	213	21.200
97	9.600	7.400	-0.1286	321	32.000	-15.000	-0.1305	214	21.300
98	9.700	7.300	-0.1287	322	32.100	-15.100	-0.1304	215	21.400
99	9.800	7.200	-0.1287	323	32.200	-15.200	-0.1304	216	21.500
100	9.900	7.100	-0.1286	324	32.300	-15.300	-0.1304	217	21.600
101	10.000	7.000	-0.1286	325	32.400	-15.400	-0.1304	218	21.700
102	10.100	6.900	-0.1287	326	32.500	-15.500	-0.1304	219	21.800
103	10.200	6.800	-0.1286	327	32.600	-15.600	-0.1304	220	21.900
104	10.300	6.700	-0.1286	328	32.700	-15.700	-0.1305	221	22.000
105	10.400	6.600	-0.1286	329	32.800	-15.800	-0.1304	222	22.100
106	10.500	6.500	-0.1286	330	32.900	-15.900	-0.1305	223	22.200
107	10.600	6.400	-0.1286	331	33.000	-16.000	-0.1305	224	22.300
108	10.700	6.300	-0.1286	332	33.100	-16.100	-0.1305		
109	10.800	6.200	-0.1286	333	33.200	-16.200	-0.1305		
110	10.900	6.100	-0.1286	334	33.300	-16.300	-0.1306		
111	11.000	6.000	-0.1286	335	33.400	-16.400	-0.1306		
112	11.100	5.900	-0.1285	336	33.500	-16.500	-0.1307		

113	11.200	5.800	-0.1285	337	33.600	-16.600	-0.1308
114	11.300	5.700	-0.1285	338	33.700	-16.700	-0.1309
115	11.400	5.600	-0.1285	339	33.800	-16.800	-0.1310
116	11.500	5.500	-0.1280	340	33.900	-16.900	-0.1311
117	11.600	5.400	-0.1268	341	34.000	-17.000	-0.1313

0.002727

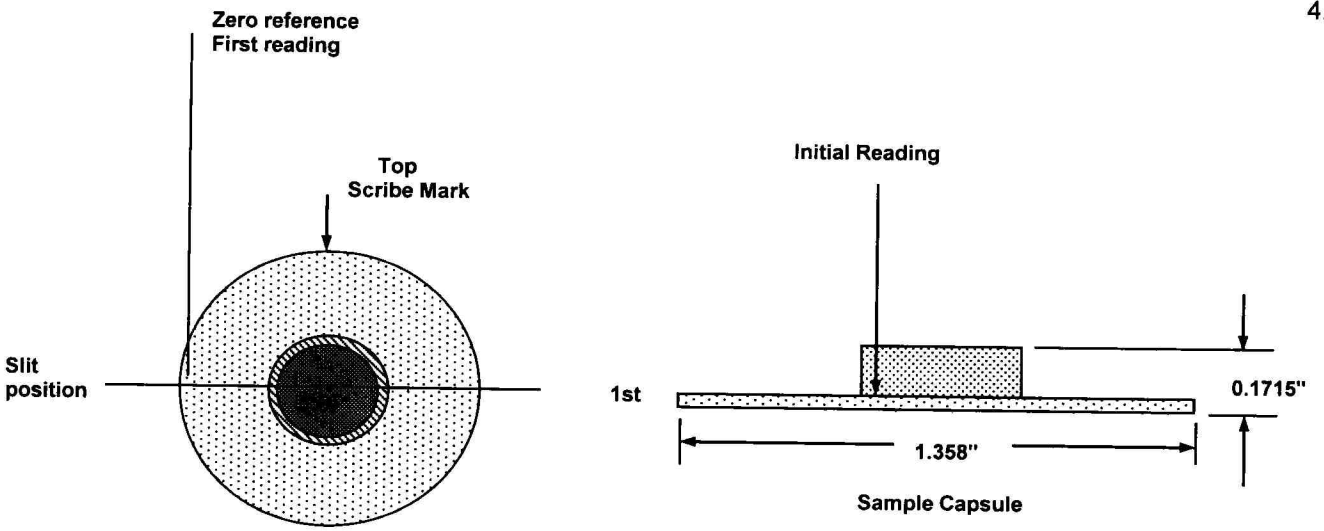
abs dist.	1st Run Reading	2nd Run Reading	3 rd Run Reading
mm	Inches	Inches	Inches
5.300			
5.200			
5.100			
5.000			
4.900			
4.800			
4.700	-0.00073		
4.600	-0.00089		
4.500	-0.00101	-0.00236	
4.400	-0.00092	-0.00232	
4.300	-0.00063	-0.00203	
4.200	-0.00054	-0.00179	
4.100	-0.00051	-0.00166	-0.00306
4.000	-0.00042	-0.00147	-0.00297
3.900	-0.00043	-0.00148	-0.00278
3.800	-0.00039	-0.00134	-0.00249
3.700	-0.00036	-0.00131	-0.00236
3.600	-0.00037	-0.00127	-0.00232
3.500	-0.00033	-0.00118	-0.00213
3.400	-0.00030	-0.00115	-0.00205
3.300	-0.00026	-0.00106	-0.00196
3.200	-0.00027	-0.00107	-0.00192
3.100	-0.00023	-0.00098	-0.00173
3.000	-0.00025	-0.00095	-0.00170
2.900	-0.00021	-0.00091	-0.00161
2.800	-0.00017	-0.00082	-0.00152
2.700	-0.00019	-0.00079	-0.00144
2.600	-0.00015	-0.00075	-0.00135
2.500	-0.00016	-0.00076	-0.00136
2.400	-0.00018	-0.00073	-0.00128
2.300	-0.00014	-0.00069	-0.00124
2.200	-0.00010	-0.00060	-0.00110
2.100	-0.00011	-0.00061	-0.00106
2.000	-0.00008	-0.00058	-0.00103
1.900	-0.00009	-0.00054	-0.00094
1.800	-0.00010	-0.00055	-0.00095
1.700	-0.00007	-0.00052	-0.00092
1.600	-0.00008	-0.00048	-0.00083
1.500	-0.00009	-0.00049	-0.00084
1.400	-0.00006	-0.00041	-0.00071
1.300	-0.00007	-0.00032	-0.00062
1.200	-0.00008	-0.00038	-0.00068
1.100	-0.00005	-0.00030	-0.00055
1.000	-0.00006	-0.00031	-0.00056
0.900	-0.00003	-0.00028	-0.00048
0.800	-0.00004	-0.00029	-0.00049
0.700	0.00000	-0.00020	-0.00040
0.600	-0.00002	-0.00022	-0.00037
0.500	0.00002	-0.00013	-0.00028
0.400	0.00001	-0.00009	-0.00024
0.300	-0.00001	-0.00011	-0.00026
0.200	-0.00002	-0.00012	-0.00022

0.100	0.00001	-0.00009	-0.00019
0.000	0.00000	-0.00005	-0.00015
-0.100	0.00004	-0.00001	-0.00011
-0.200	-0.00003	-0.00003	-0.00008
-0.300	0.00001	0.00001	0.00001
-0.400	-0.00001	-0.00001	-0.00001
-0.500	0.00003	0.00003	0.00003
-0.600	0.00002	0.00007	0.00007
-0.700	0.00000	0.00005	0.00005
-0.800	0.00004	0.00009	0.00014
-0.900	0.00002	0.00012	0.00017
-1.000	0.00001	0.00011	0.00016
-1.100	-0.00001	0.00009	0.00014
-1.200	0.00003	0.00013	0.00018
-1.300	0.00001	0.00011	0.00021
-1.400	0.00000	0.00010	0.00020
-1.500	-0.00001	0.00009	0.00019
-1.600	-0.00003	0.00012	0.00027
-1.700	-0.00004	0.00006	0.00021
-1.800	-0.00001	0.00014	0.00029
-1.900	-0.00002	0.00013	0.00023
-2.000	-0.00004	0.00011	0.00021
-2.100	-0.00005	0.00015	0.00030
-2.200	-0.00007	0.00008	0.00023
-2.300	-0.00008	0.00012	0.00027
-2.400	-0.00010	0.00010	0.00025
-2.500	-0.00011	0.00009	0.00024
-2.600	-0.00013	0.00007	0.00022
-2.700	-0.00009	0.00011	0.00026
-2.800	-0.00011	0.00009	0.00024
-2.900	-0.00017	0.00003	0.00023
-3.000	-0.00014	0.00006	0.00021
-3.100	-0.00020	0.00000	0.00015
-3.200	-0.00022	-0.00007	0.00003
-3.300	-0.00023	-0.00008	0.00002
-3.400	-0.00030	-0.00015	-0.00005
-3.500	-0.00026	-0.00016	-0.00011
-3.600	-0.00033	-0.00023	-0.00023
-3.700	-0.00034	-0.00024	-0.00024
-3.800	-0.00036	-0.00031	-0.00036
-3.900	-0.00037	-0.00032	-0.00047
-4.000	-0.00044	-0.00039	-0.00069
-4.100	-0.00046	-0.00046	-0.00071
-4.200	-0.00057	-0.00067	-0.00082
-4.300	-0.00064	-0.00084	-0.00084
-4.400	-0.00090	-0.00130	
-4.500	-0.00107	-0.00167	
-4.600	-0.00128	-0.00128	
-4.700	-0.00120		
-4.800	-0.00066		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			

SAMPLE CAPSULE: **6** 6/7/2010
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER # 3

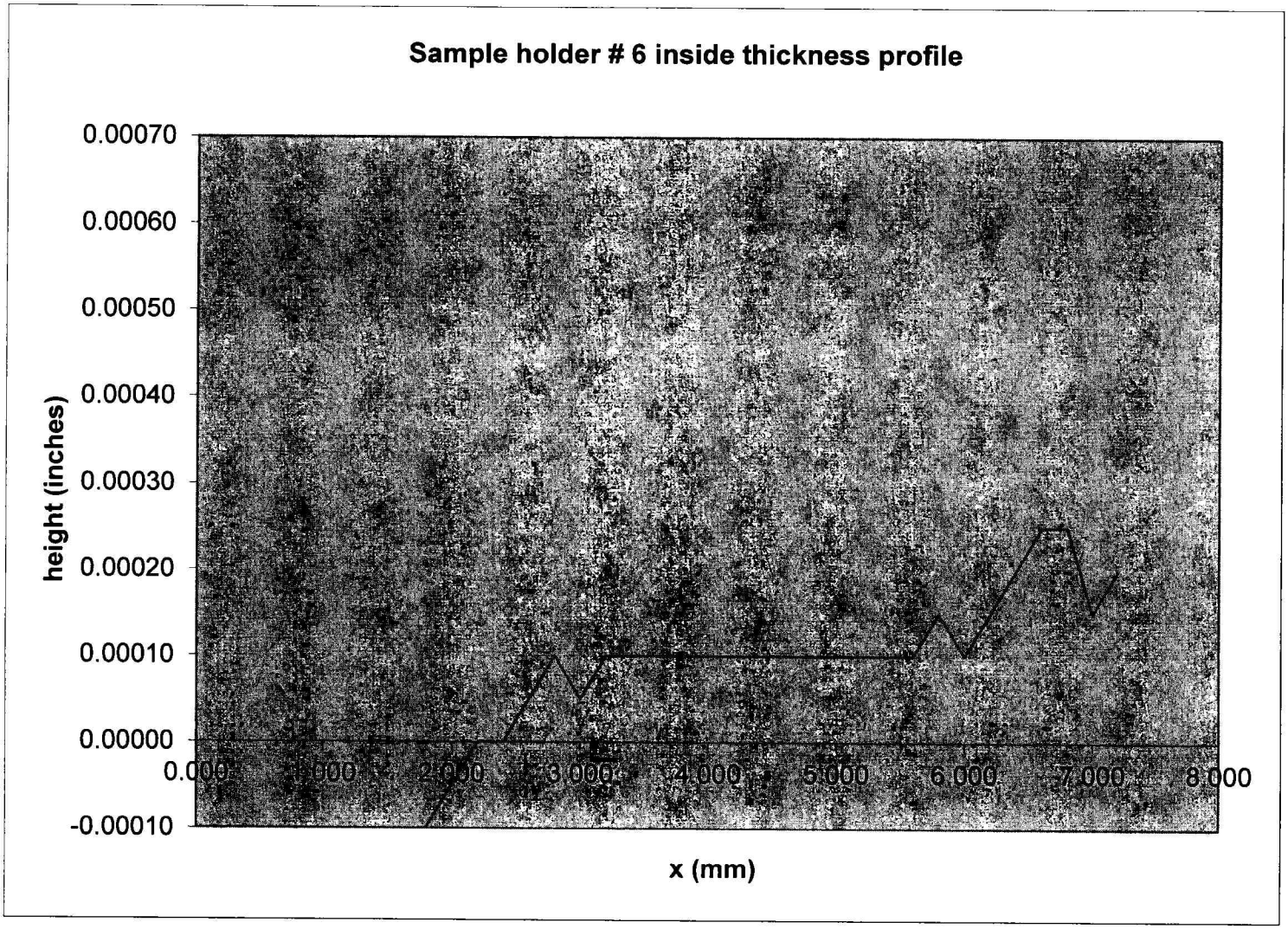
4.617
4.64



1.338582677

Average thickness reading = 0.00003

Note: The thickness of the reference zero point from the base is = 0.39250 Inches
9.9695 mm


Sample holder # 6 inside thickness profile
0.00070
0.00060
0.00050
0.00040
0.00030
0.00020
0.00010
0.00000
-0.00010
height (inches)
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

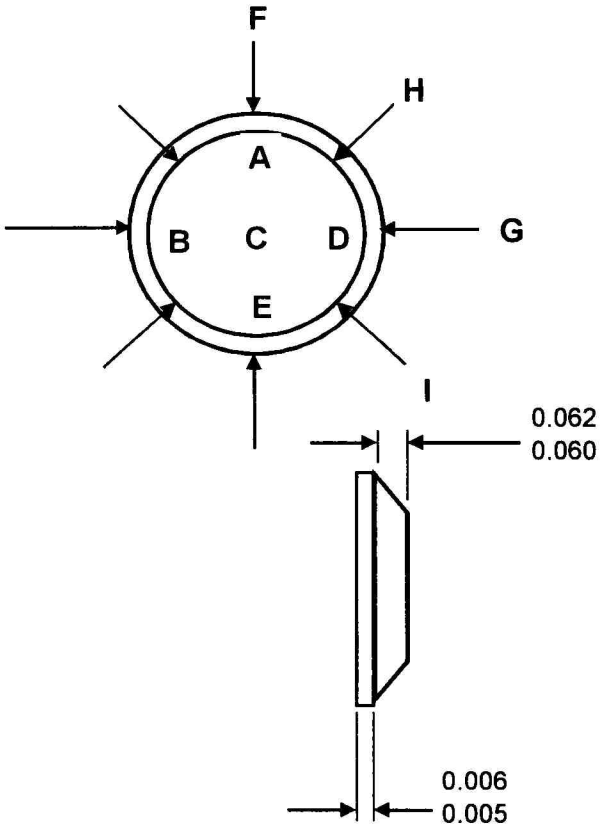
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	-0.00010	3.504	south
2	0.200	-0.00010	3.30400	
3	0.400	-0.00015	3.10400	
4	0.600	-0.00015	2.90400	
5	0.800	-0.00010	2.70400	
6	1.000	-0.00010	2.50400	
7	1.200	-0.00010	2.30400	
8	1.400	-0.00010	2.10400	
9	1.600	-0.00010	1.90400	
10	1.800	-0.00010	1.70400	
11	2.000	-0.00005	1.50400	
12	2.200	0.00000	1.30400	
13	2.400	0.00000	1.10400	
14	2.600	0.00005	0.90400	
15	2.800	0.00010	0.70400	
16	3.000	0.00005	0.50400	
17	3.200	0.00010	0.30400	
18	3.400	0.00010	0.10400	
19	3.600	0.00010	-0.09600	
20	3.800	0.00010	-0.29600	
21	4.000	0.00010	-0.49600	
22	4.200	0.00010	-0.69600	
23	4.400	0.00010	-0.89600	
24	4.600	0.00010	-1.09600	
25	4.800	0.00010	-1.29600	
26	5.000	0.00010	-1.49600	
27	5.200	0.00010	-1.69600	
28	5.400	0.00010	-1.89600	
29	5.600	0.00010	-2.09600	
30	5.800	0.00015	-2.29600	
31	6.000	0.00010	-2.49600	
32	6.200	0.00015	-2.69600	
33	6.400	0.00020	-2.89600	
34	6.600	0.00025	-3.09600	
35	6.800	0.00025	-3.29600	
36	7.000	0.00015	-3.49600	
37	7.200	0.00020	-3.69600	north

SHOT No.

FLYER PLATE MATERIAL: **Ta # 22** 4/23/2010

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06105	F	0.81400
A	0.06110	F	0.81350
B	0.06100	G	0.81400
B	0.06110	G	0.81350
C	0.06110	H	0.75000
C	0.06110	H	0.75000
D	0.06100	I	0.75000
D	0.06100	I	0.75000
E	0.06090		
E	0.06095		



Statistic for thickness

N	10	
MAX	0.06110	
MIN	0.06090	
Range	0.00020	
MEAN	0.061057143	inch
	1.550851429	mm
STDEV	5.34522E-05	

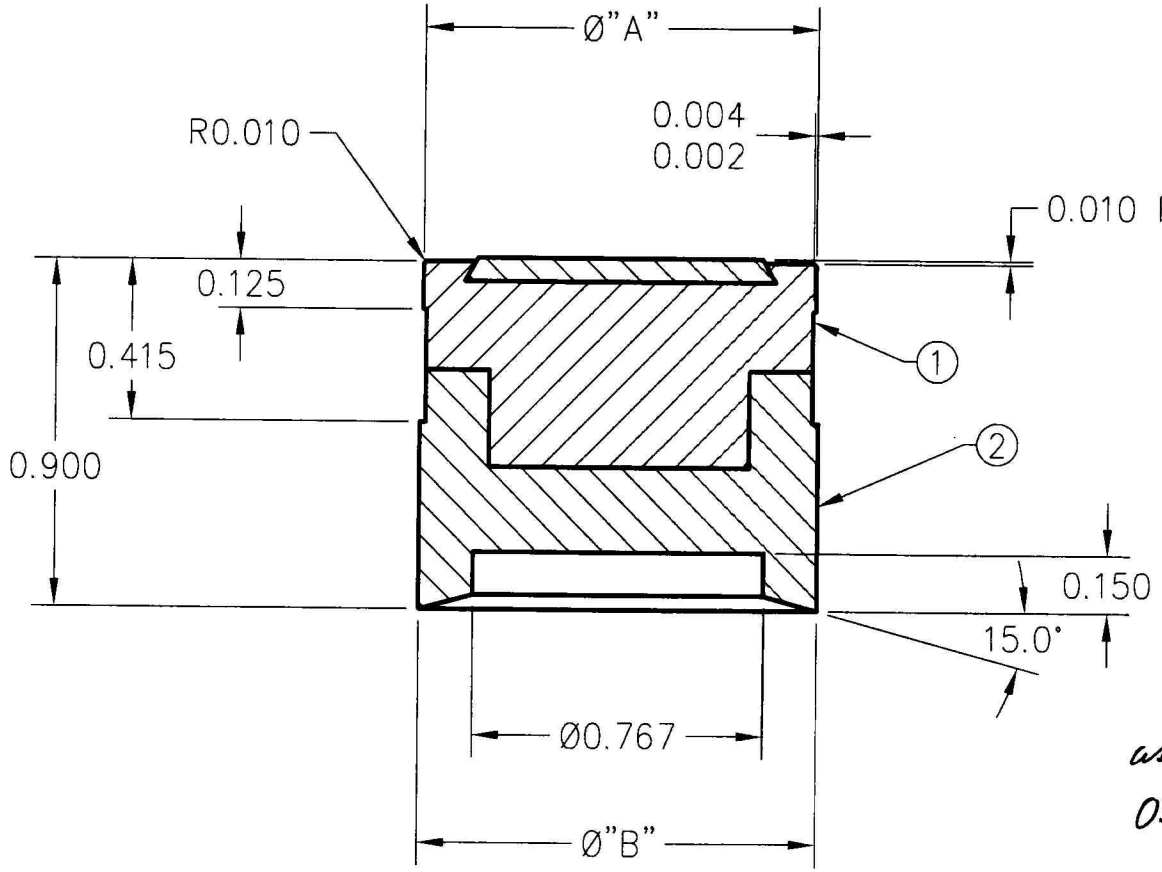
Statistic for Diameter (F-G)

N	4	
MAX	0.81400	
MIN	0.81350	
Range	0.00050	
MEAN	0.8137500	inch
	20.6692500	mm
STDEV	0.000288675	

Statistic for Diameter (H-I)

N	4	
MAX	0.75000	
MIN	0.75000	
Range	0.00000	
MEAN	0.75	inch
	19.05	mm
STDEV	0	

DENSITY MEASUREMENT BY:			Russ	4/23/2010		
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.6	1.88263	8.03300	9.49787	0.8642	16.6167
2	21.6	1.88269	8.03301	9.49790	0.8642	16.6151
3	21.6	1.88270	8.03299	9.49793	0.8642	16.6167
	THICKNESS		0.061057143	±		in
	FLATNESS:		0.00020	in.		
	VOLUME:		0.5204	1.05E-03		cm^3
	CRYSTAL DENSITY:		16.6162	9.01E-04		$grams/cm^3$
	BULK DENSITY:		15.4372	1.05E-03		$grams/cm^3$
	DENSITIES CHECKED BY: _____ on _____					
	MEASUREMENT CHECKED BY: _____ on _____					



as built:
0.9795
0.9900

Ta 0.0611 8/14/10

SHOT# 4/4		
A	0.9800	+.0000 −.0005
B	0.9900	+.0005 −.0000

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-048	1
1	Sabot & Flyer Plate	LGG-049	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

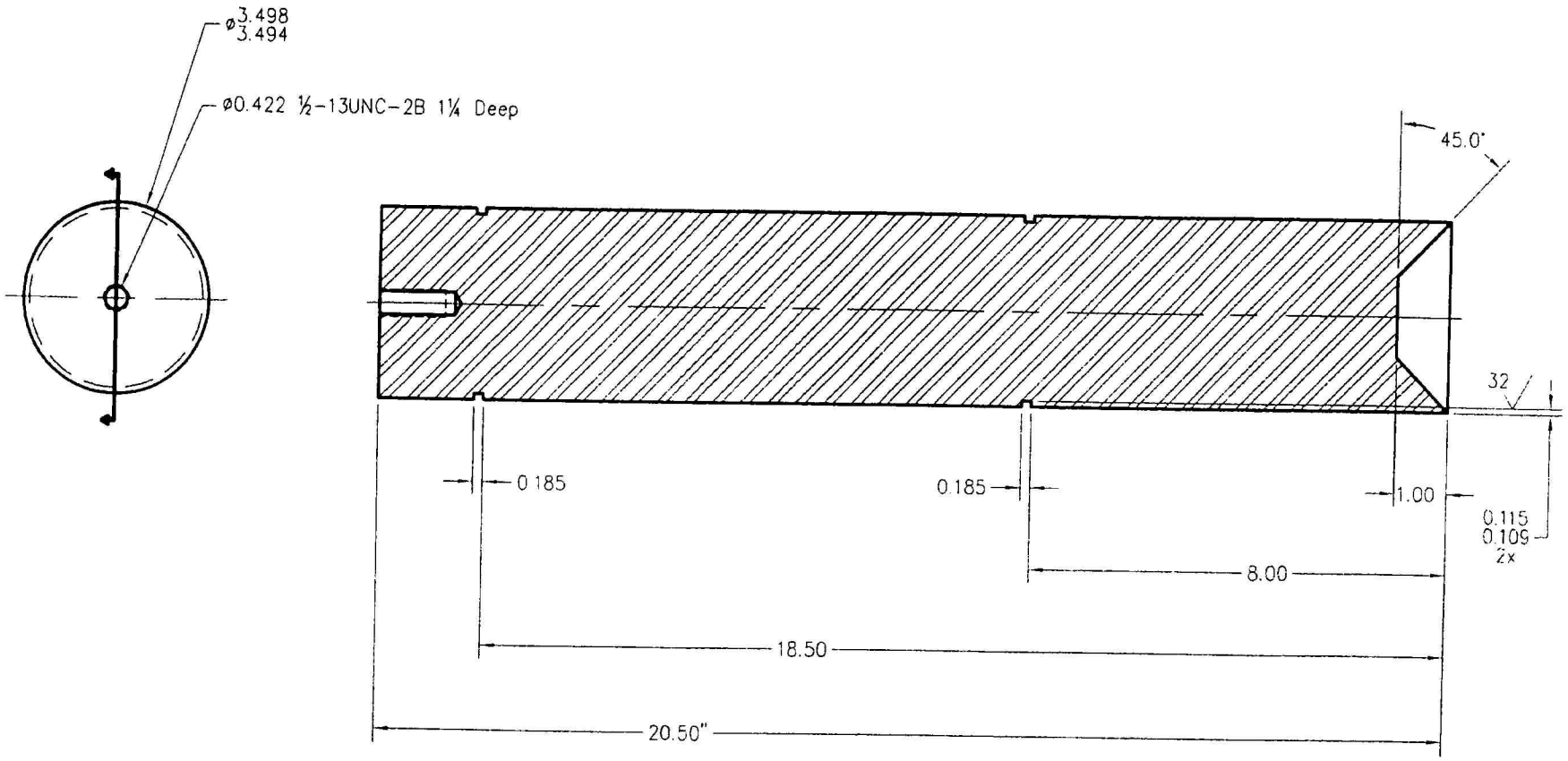
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN	DATE
M. Long	1/23/04
ENGINEER	DATE
APPROVED	DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy.

FINISH	MATERIAL	SCALE	SHEET		DRAWING NUMBER
16	Zelux-M&HDP	2:1	2 of 2	A	LGG-050



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS
FINISH 63

DRAWN	M. Long	DATE 10/04/01
ENGINEER		DATE
APPROVED		DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: PISTON -1 Piece

MATERIAL: H.D. POLY
SCALE: 1:2
SHEET: 1 of 1
B
DRAWING NUMBER: LGG-029

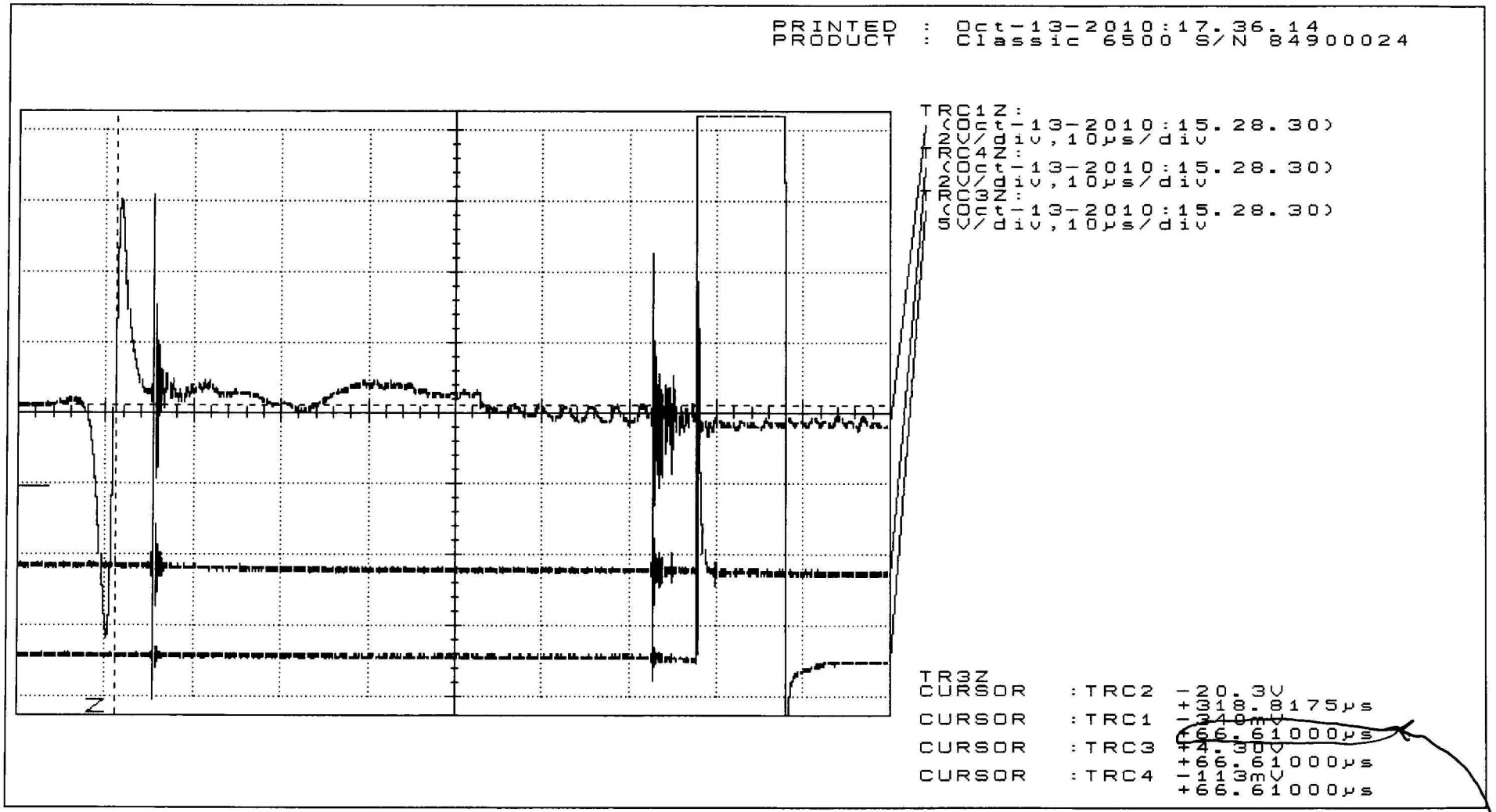
Shot 414 Nominal Timeline Preshot

V	6200				
cable time	90	150		M1-M2 distance	0.203606
tervalometer intrinsic delay	[redacted]			M2-target distance	0.215544
UDC extra count lag	[redacted]			M2-target fudge	[redacted]
pulse translator delay	150			M1-fid1 distance	0.03
X-ray 1 program delay	[redacted]	1740	X-ray 1 actual delay	M1-fid2 distance	0.383145
X-ray 2 program delay	[redacted]	59150	X-ray 2 actual delay	Flyer thickness	0.001552
X-ray 1 pulser delay	600				
X-ray 2 pulser delay	[redacted]			Us(Mo)	9347.40481
Camera intrinsic delay	107			driver thickness	0.001187
Streak duration	1514			estimated sample+cover time	400
d dead streak before driver	600				

t (ns)	flyer x (m)	shock front (m)	event
0	0.000776		M1 zero-crossing
150	0.001706		HP5-1, GS7-1, Intervalometer start
2230	0.014602		HP5-3, UDC start, signal to pulse translator
2380	0.015532		pulse translator out, GS7 trig
4120	0.02632		X-ray 1 delay amp out to counters 4, 5
4810	0.030598		X-ray 1 fires
4900	0.031156		X-ray 1 pulse monitor at counter 4b
32840	0.204382		M2 zero-crossing
32990	0.205312		HP5-2, Intervalometer stop
35070	0.218208		HP5-4, UDC stop
61530	0.382262		X-ray 2 delay amp, stop counter 4, start counter 6
62245	0.386695		X-ray 2 fires
62335	0.387253		X-ray 2 pulse monitor at counter 4b
66810	0.41499592		UDC out, GS7-3, stop counters 5 and 6
66900	0.41555392		Trigger at camera
67007	0.41621732		Begin Streak
67097	0.41677532		Camera Monitor on GS7-4
67480	0.41915	0	IMPACT
67607		0.001187	Driver arrival on streak
68007		0.004925962	Sample cutoff on streak
68521		0.009730528	End Streak

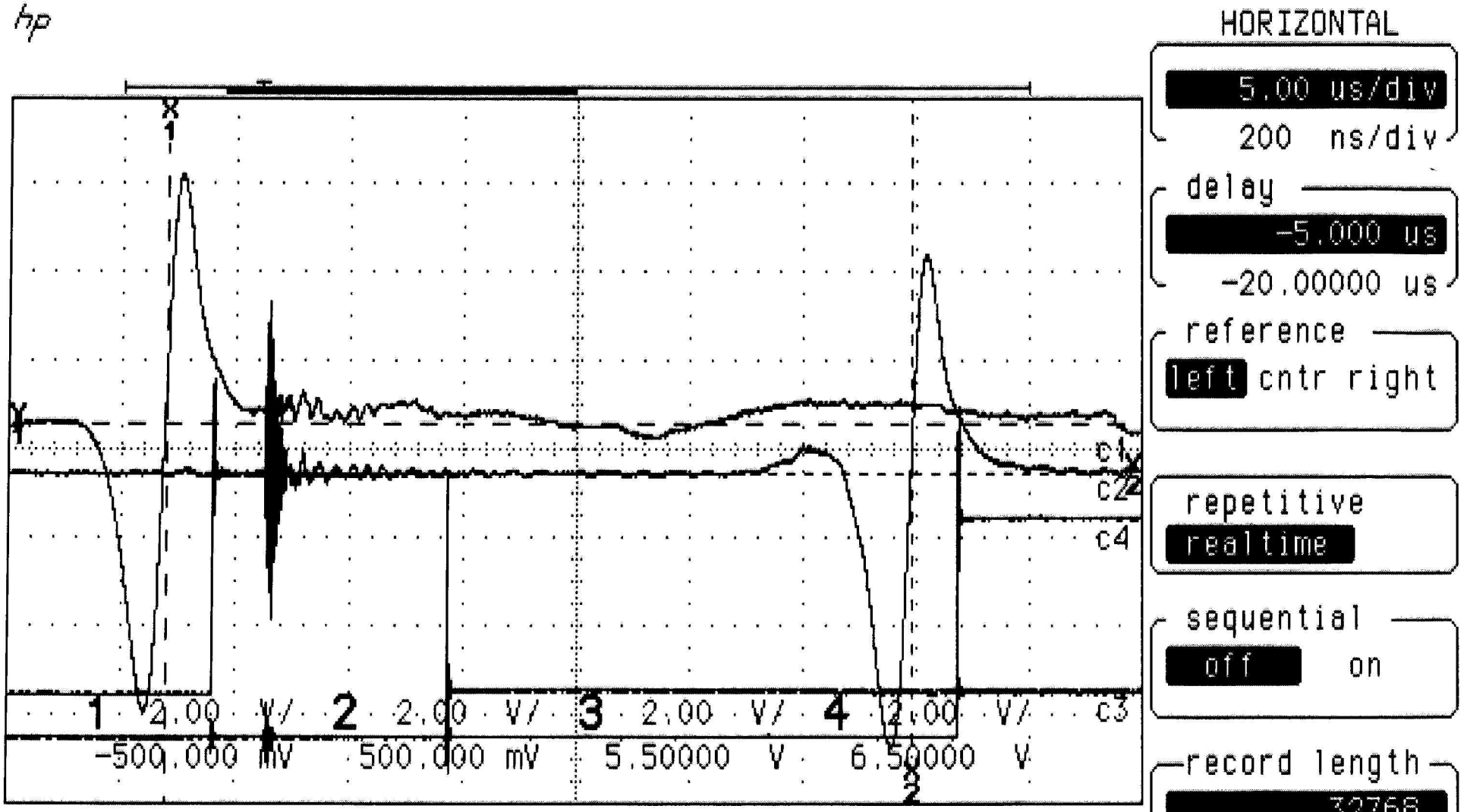
				X-ray velocity	6200
					On film
X-ray 1 flyer vs. fid (mm)				0.598	0.69534884
Counter 3:	32840				
				HP5 2-1	32840
UDC upcount:	32840			HP5 4-3	32840
Counter 4:	57410				
X-ray 2 flyer vs. fid (mm)				3.55	4.12790698
Counter 4b:	57435				
Counter 5:	62690			GS7 3-1	66660
Counter 6:	5280			GS7 4-1	66947
Driver cutoff on streak	600				
Sample cutoff on sreak	1000				

GS7 Shot 414



Velocity magnet 1 to Camera Trig interval
(UDC HV#1)

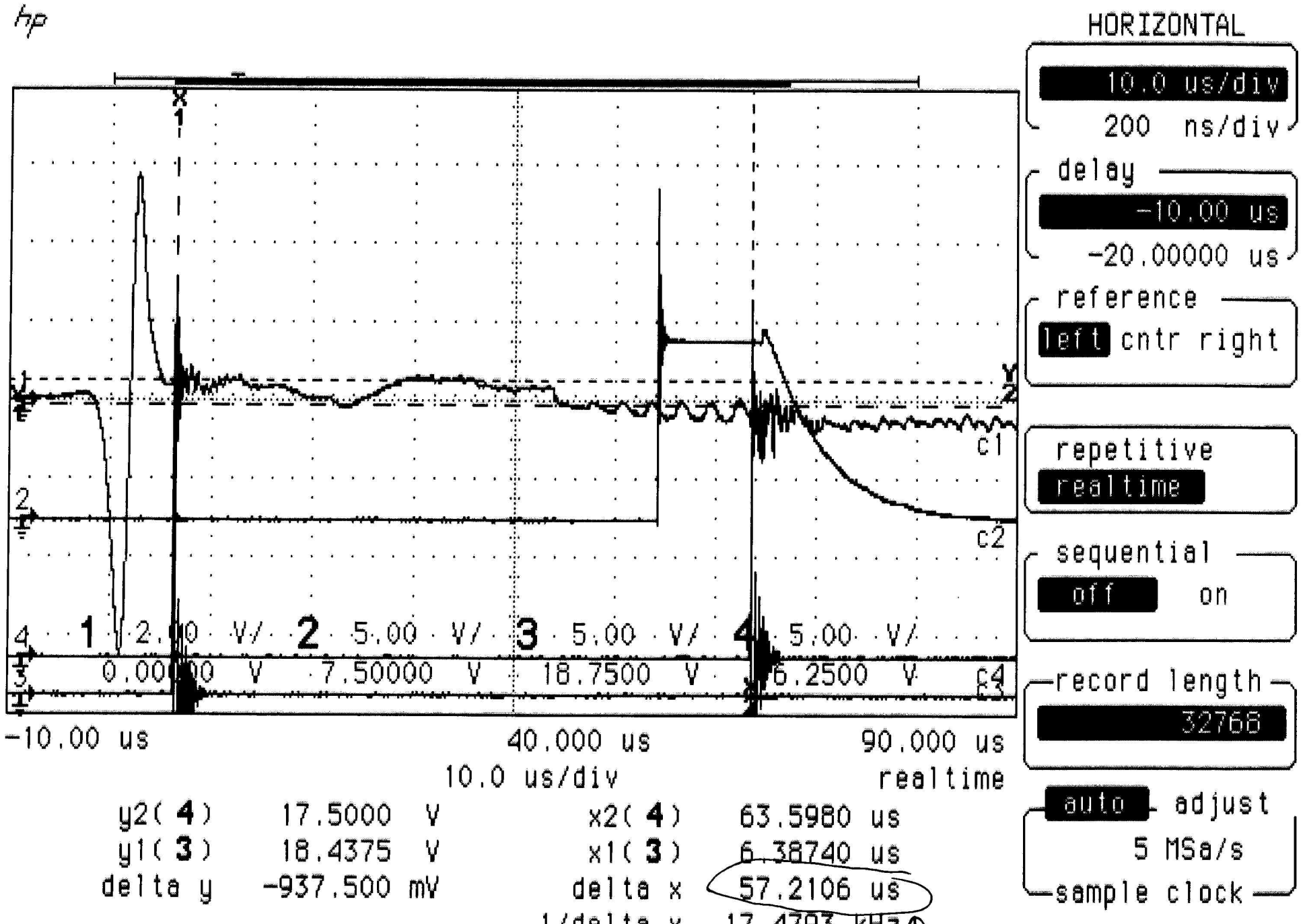
HPS Shot 414



y2(2)	-62.5000 mV	x2(2)	34.8000 us
y1(1)	62.5000 mV	x1(1)	1.96400 us
delta y	-125.000 mV	delta x	32.8360 us
		1/delta x	30.4544 kHz

Magnet 1 to 2 interval

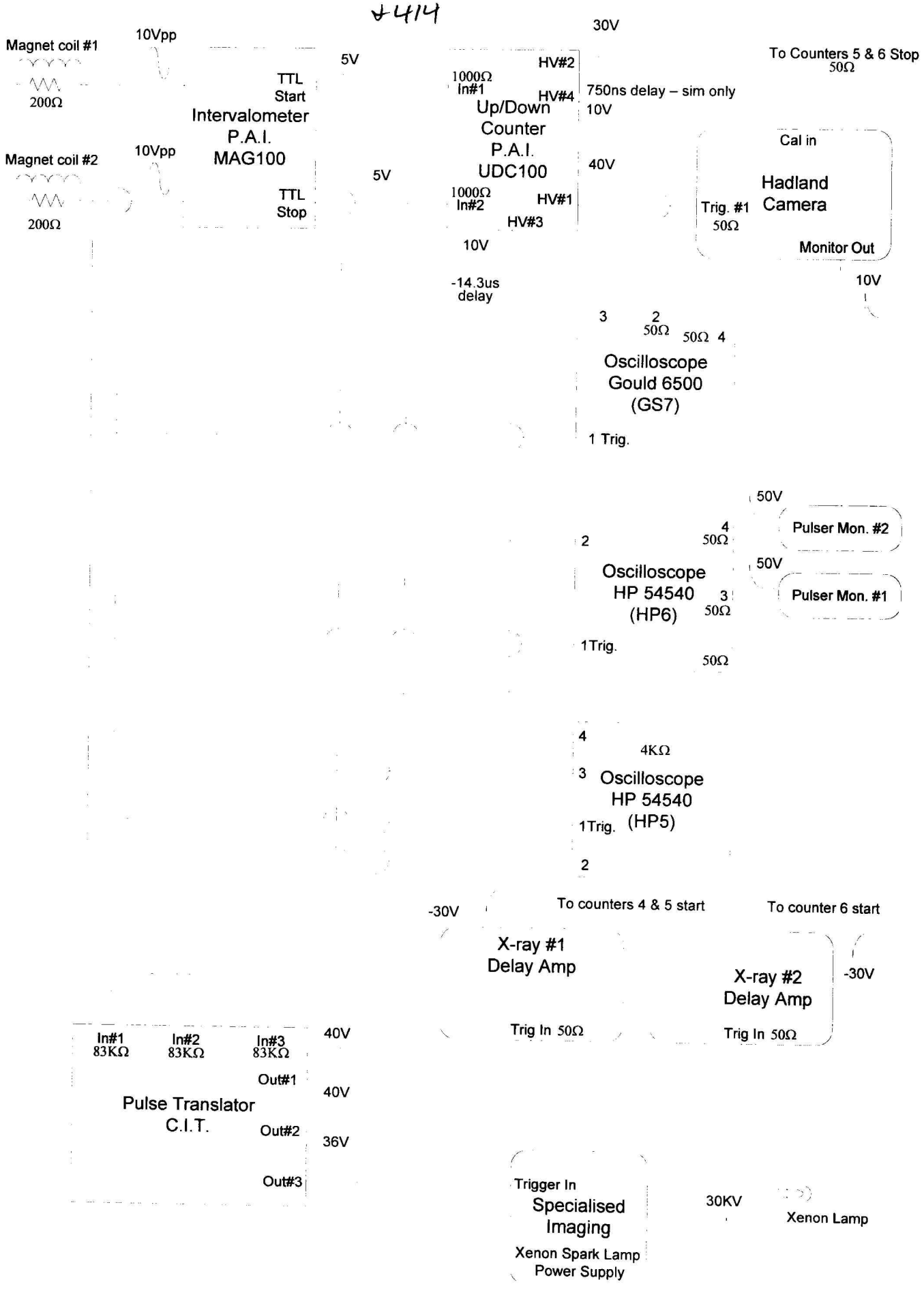
HP6 Shot 414



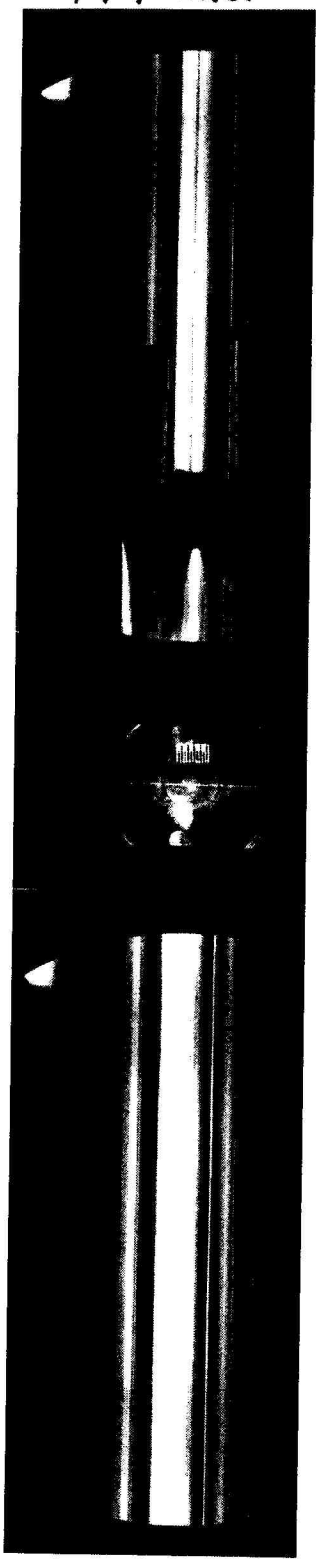
xray 1 to 2 interval

Shot #413 Scope Schematic

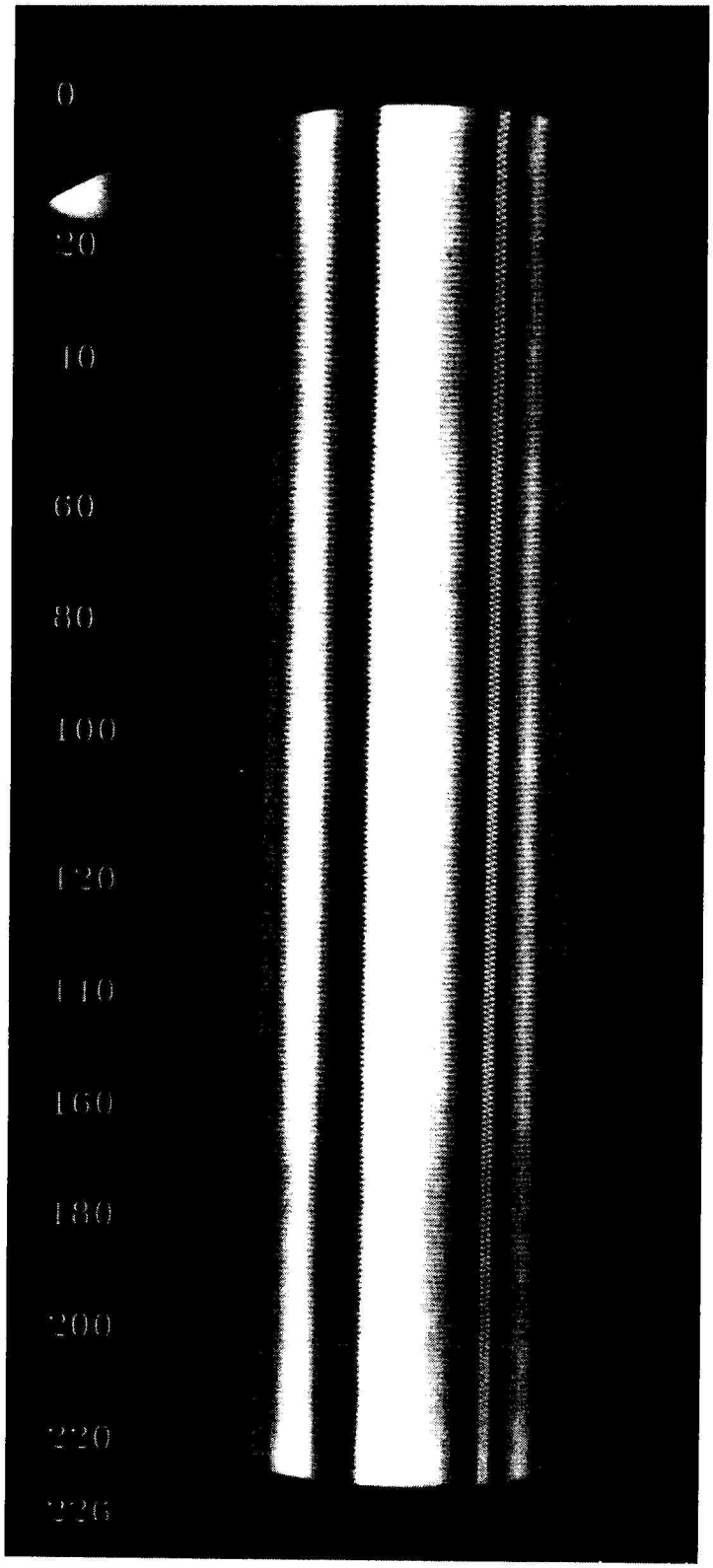
#414



414 Shot

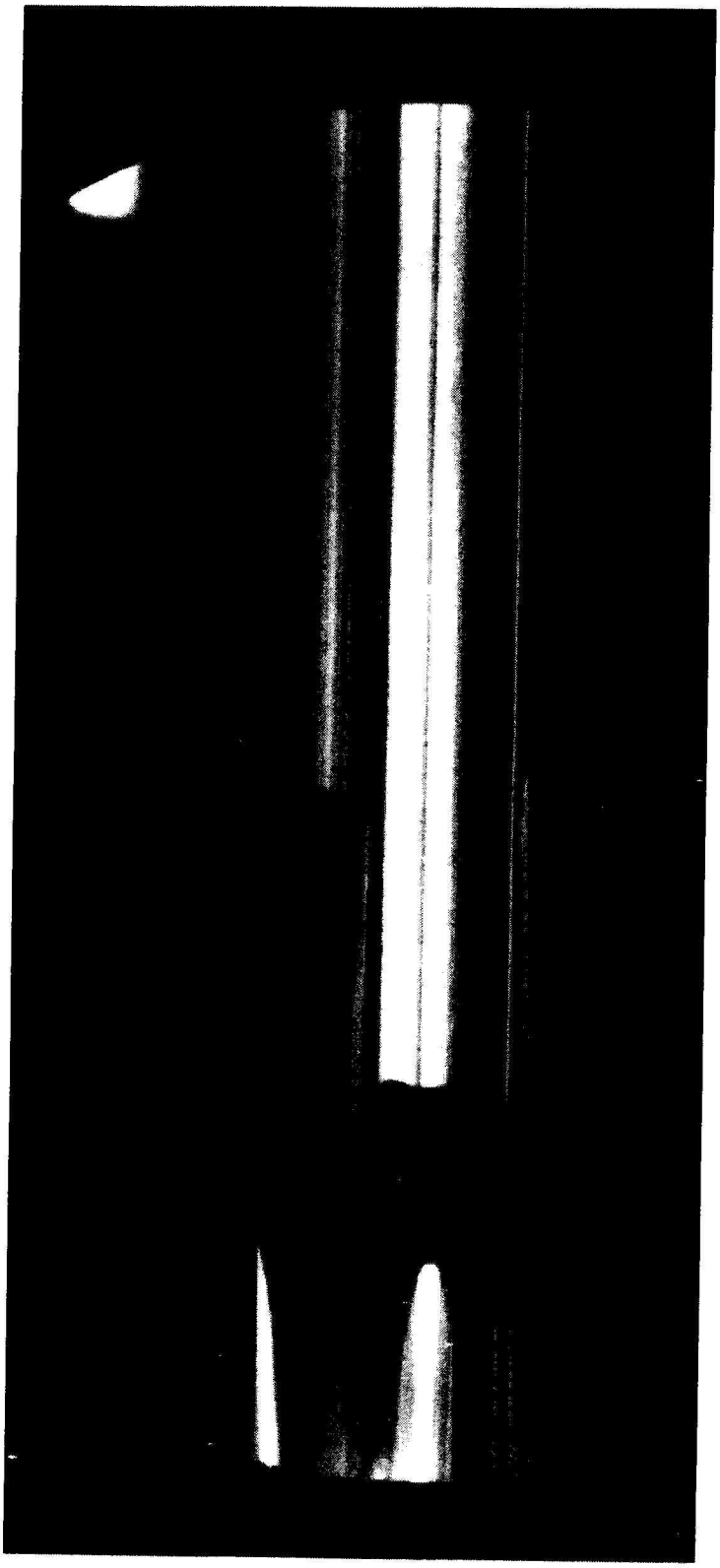


414 Cal.

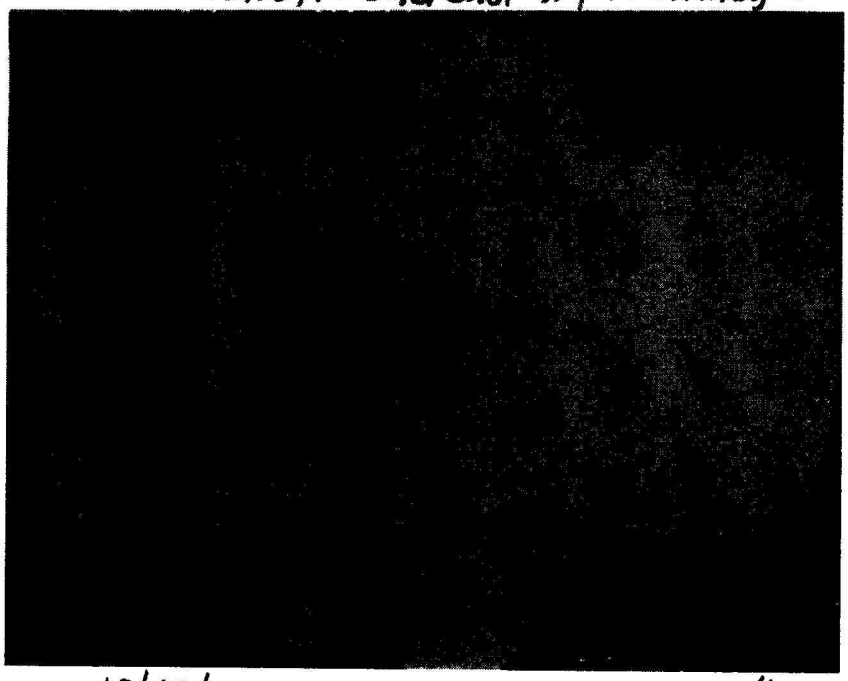


$\frac{1}{147.9993\,MHz} \times 226 = 1527\,ns$

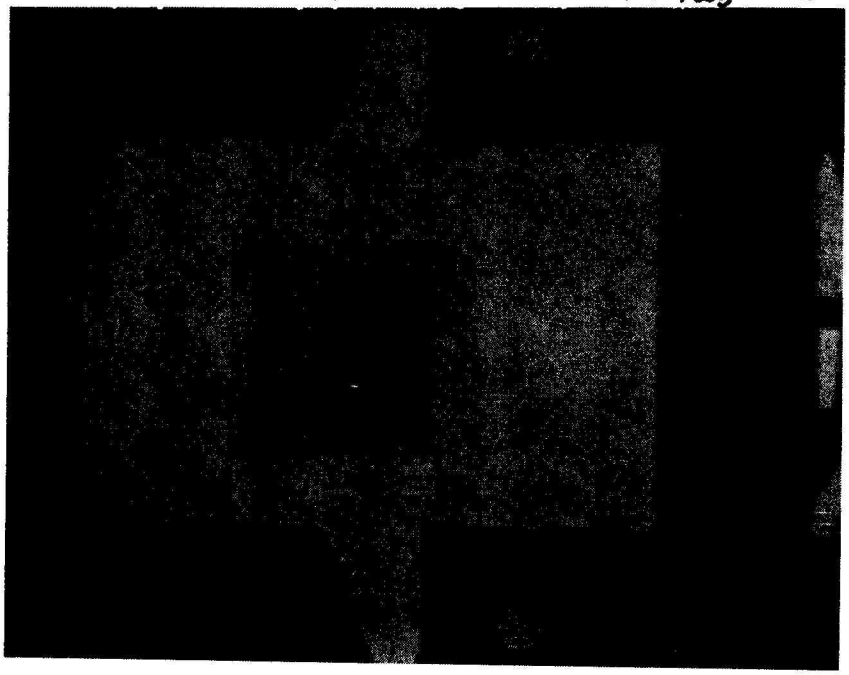
414 Slot



10/13/10 LGG Shot 414 Flash Xray #1



10/13/10 LGG Shot 414 Flash Xray #2



LIGHT GAS GUN DATA SHEET

Shot No. 415 Date 10/26/10

Target:

Sample Material Hedenbergite #7 Crystallographic orientation _____

Source Location Univ. of Michigan Thickness:1 _____ in.

Type of Measurement _____ 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in.

Material _____

Projectile:

Weight 18.225 gms. Length 0.9070 in. Skirt Diameter 0.9905 in.

Flyer Plate Material Ta Leading Edge Dia. 0.9798 in.

Thickness 0.0614 in. Major Dia. 0.8136 in. Depth Inserted 2 in.

Minor Dia. 0.75 in. Force: 100 pounds

Barrel Dimensions:

Breech Diameter 0.9874 in. Muzzle Diameter 0.980 in. Taper 0.0074 in.

Ellipticity @ projectile depth insertion point 0.0012 in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.112 in.

Diameter: Front 3.496 in. Back 3.497 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 658 gms. Type IMR 4350 Total Charge 670 gms.

Primer Charge 12 gms. Type IMR4350

Expected Velocity:

Projectile 5.6 km/sec Piston 0.666 km/sec

Notes: Temp @ shot time: 1400°C 4:50 heating time ramp up

7:20 total time heating

L.G.G.

Camera Streak Duration: ~~1500~~ 1520 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.84

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 2.26 µsec Flash X-ray #2 65.77 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0558 in. min.	0.0919 in. min.
0.0562 in. max.	0.0922 in. max

Expected Burst Pressure 4K psi

Instrument Tank/Vacuum Pump Pressure: 78/55 µm

Distances:

Muzzle to Flash X-ray Marker #1	9.9 cm
Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
Flash X-ray Marker #2 to Target	3.93 cm
Velocity Magnet #1 to #2	31.71 cm
Piston Velocity Gauge #1 to #2	30.48 cm
Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.668 km/sec

Piston Velocity from Gauge #1 to #3: 0.666 km/sec

Projectile Velocity from UDC: 5610.85 m/sec.

Projectile Velocity from X-ray: _____ km/sec.

5621 m/s

L.G.G.

COUNTER CONNECTIONS

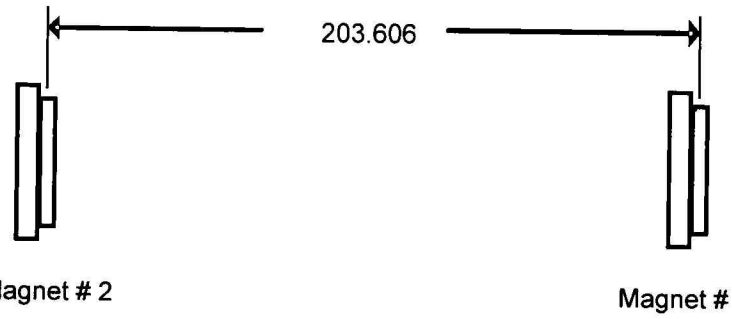
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	456 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	916 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	36.3 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	63.467 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	69.582 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	6.119 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	63.479 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	36.29 µsec
UDC Velocity:			5610.85 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 ×1 2.0896	Velocity magnet 2 ×2 38.3594	36.270 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start ×3 4.1508	2.061 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop ×4 40.4132	2.054 µsec
HP6, 1-2:	Velocity Magnet 1 ×1 2.0786	Xenon Lamp Trigger ×2 61.8902	59.812 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out ×3 7.0208	X-ray 2 Pulser Monitor Out ×4 70.4974	63.477 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	74.123 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	74.407 µsec

MAGNET DISTANCE

Shot No. **415** Expected Velocity: **5.60**



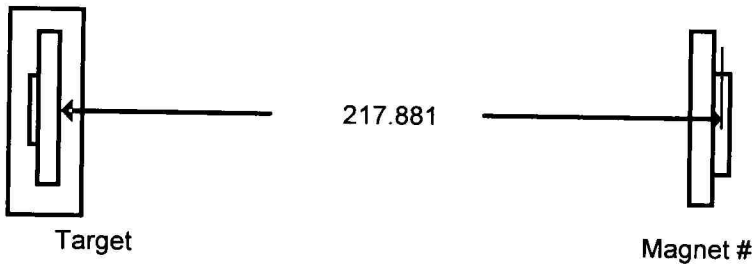
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **36.358 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.453 inch

Second measurement = 8.453 inch

Average measurement = 8.453 inch

Average measurement = 214.706 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 217.881 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **38.907 µsec.**

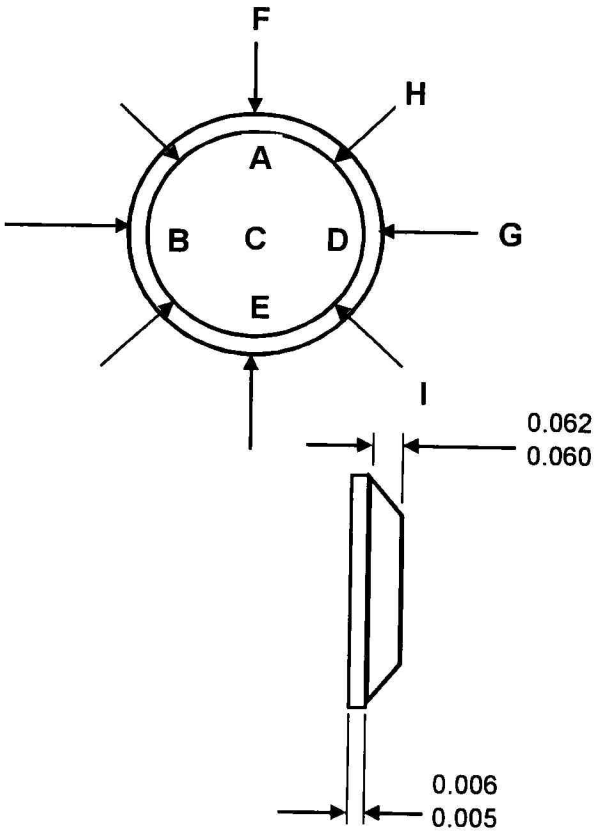
Fudged Distance between Magnet 2 to Target = ~~0 mm~~ 0.200195 m

SHOT No.

FLYER PLATE MATERIAL: **Ta # 21** 4/23/2010

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06140	F	0.81350
A	0.06150	F	0.81400
B	0.06120	G	0.81400
B	0.06130	G	0.81300
C	0.06150	H	0.75000
C	0.06140	H	0.75000
D	0.06135	I	0.75000
D	0.06140	I	0.75000
E	0.06120		
E	0.06125		



Statistic for thickness

N	10
MAX	0.06150
MIN	0.06120
Range	0.00030
MEAN	0.061378571 inch
	1.559015714 mm
STDEV	0.00010746

Statistic for Diameter (F-G)

N	4
MAX	0.81400
MIN	0.81300
Range	0.00100
MEAN	0.8136250 inch
	20.6660750 mm
STDEV	0.000478714

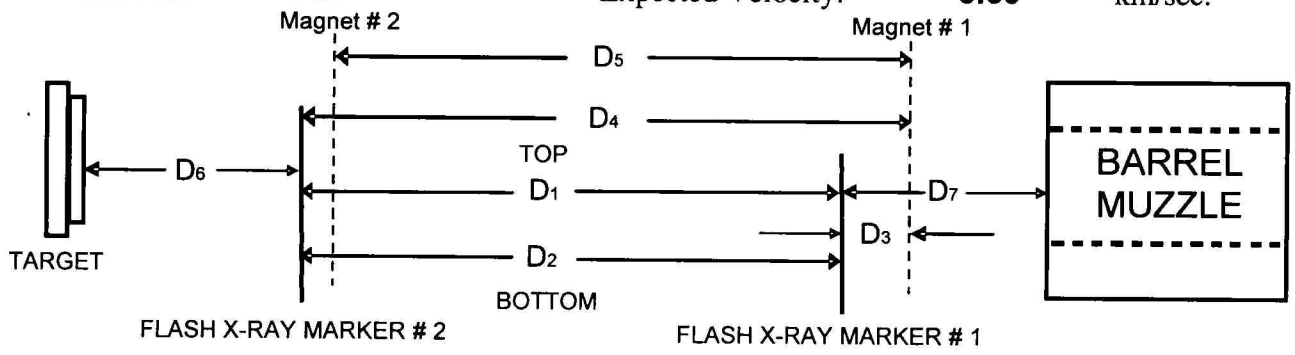
Statistic for Diameter (H-I)

N	4
MAX	0.75000
MIN	0.75000
Range	0.00000
MEAN	0.75 inch
	19.05 mm
STDEV	0

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.2	1.88186	8.06904	9.53192	0.8645	16.6498
2	21.2	1.88190	8.06909	9.53194	0.8645	16.6471
3	21.2	1.88182	8.06908	9.53193	0.8645	16.6503
	THICKNESS		0.061378571	±	in	
	FLATNESS:		0.00030	in.		
	VOLUME:		0.5229	1.74E-03	cm^3	
	CRYSTAL DENSITY:		16.6491	1.70E-03	$grams/cm^3$	
	BULK DENSITY:		15.4300	1.74E-03	$grams/cm^3$	
	DENSITIES CHECKED BY: _____ on _____					
	MEASUREMENT CHECKED BY: _____ on _____					

TARGET MEASUREMENT

Shot No. **415** Expected Velocity: **5.60** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	39.5	99.0
Measure # 2, mm	30.00	383.15	203.66	39.0	99.0
Average, mm	30.00	383.15	203.61	39.3	99.0
Travel time, µsec	**5.36**	**68.42**	**36.36**	**7.01**	**17.68**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **63.07** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **63.05** µsec.

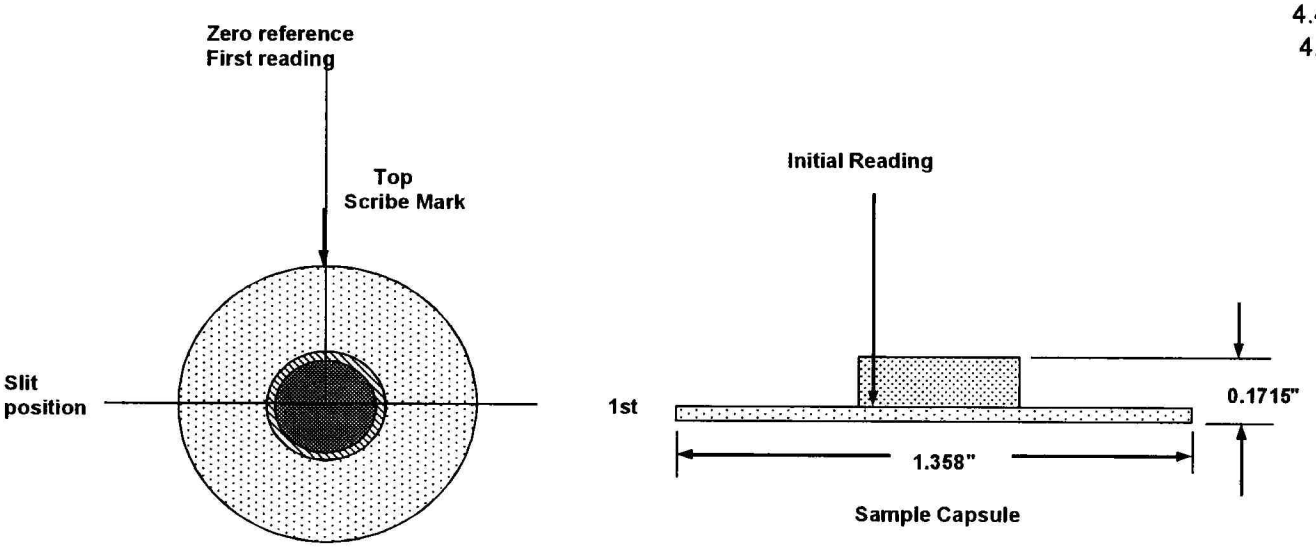
Flash X-Ray # 1 Delay (from Magnet # 1) **2.26** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **65.77** µsec.

SAMPLE CAPSULE 7 6/7/2010
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

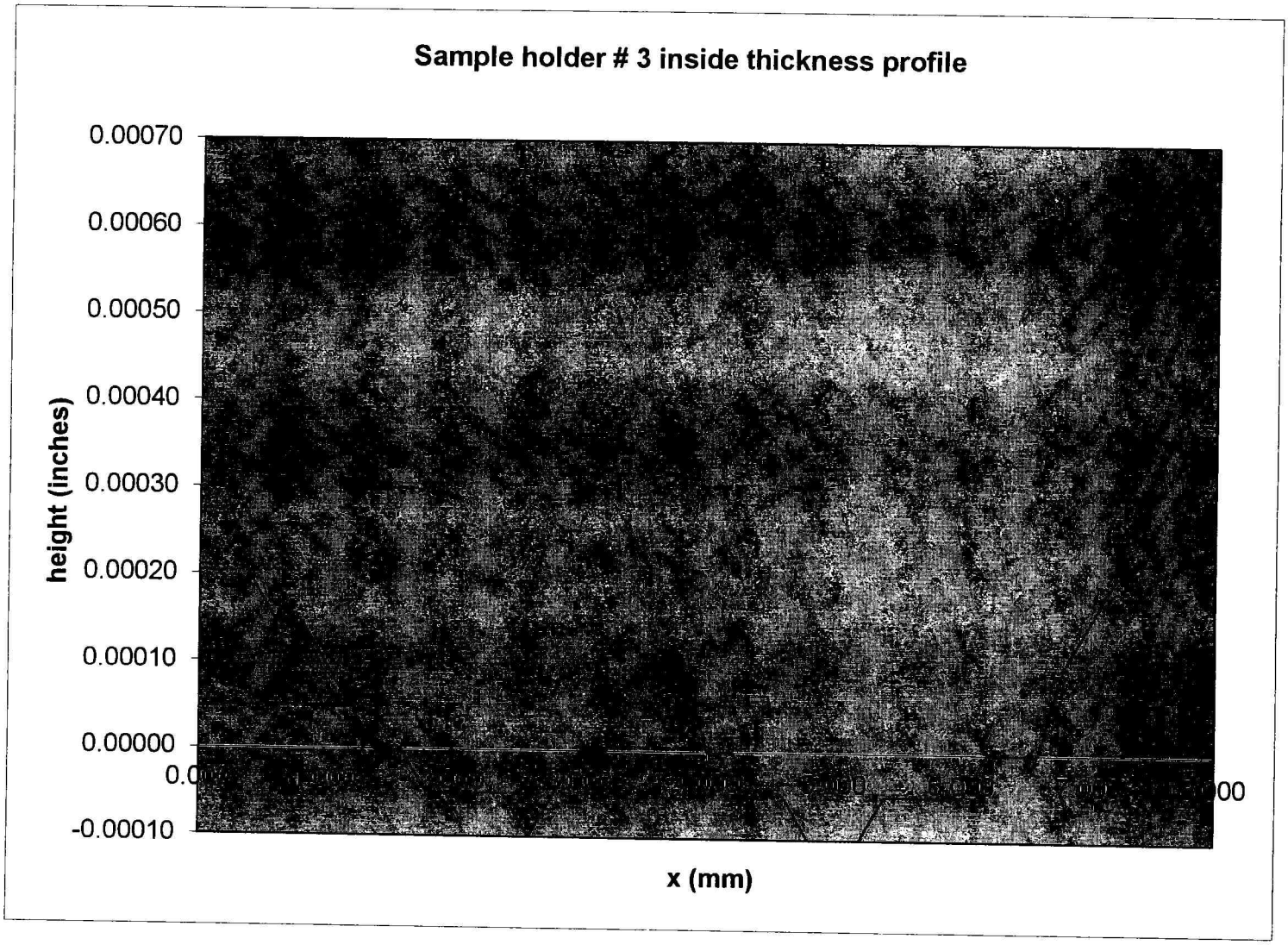
4.483
4.49



1.338582677

Average thickness reading = 0.00023

Note: The thickness of the reference zero point from the base is = 0.03960 Inches
1.00584 mm


Sample holder # 3 inside thickness profile
0.00070
0.00060
0.00050
0.00040
0.00030
0.00020
0.00010
0.00000
-0.00010
height (inches)
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

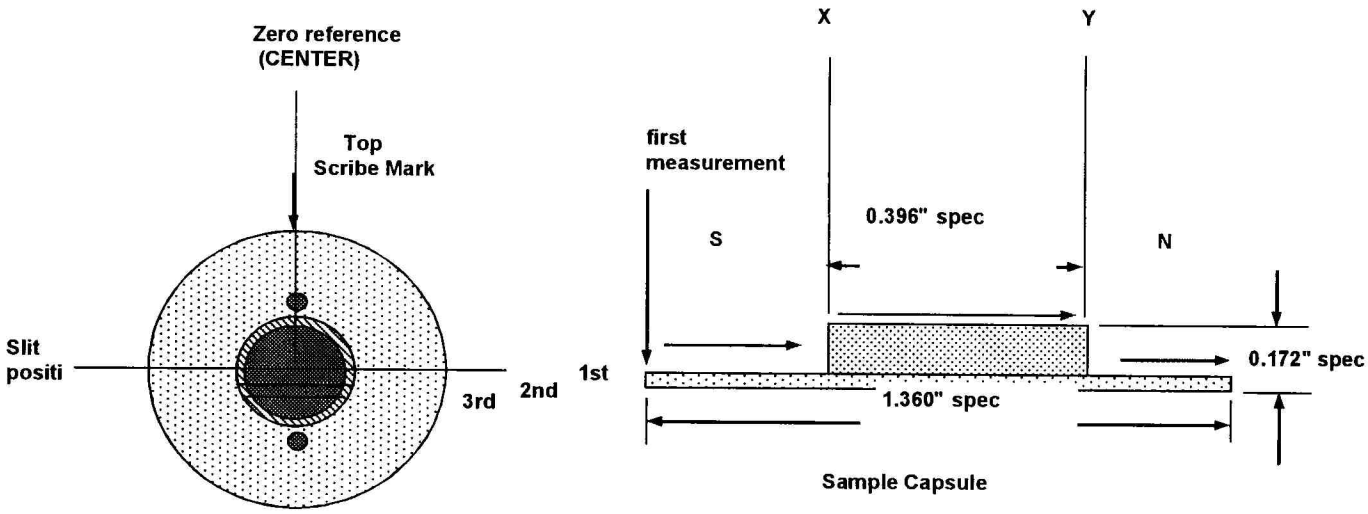
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00030	3.934	south
2	0.200	0.00030	3.73400	
3	0.400	0.00020	3.53400	
4	0.600	0.00015	3.33400	
5	0.800	0.00015	3.13400	
6	1.000	0.00010	2.93400	
7	1.200	0.00005	2.73400	
8	1.400	0.00000	2.53400	
9	1.600	0.00000	2.33400	
10	1.800	-0.00005	2.13400	
11	2.000	0.00000	1.93400	
12	2.200	-0.00005	1.73400	
13	2.400	-0.00005	1.53400	
14	2.600	-0.00010	1.33400	
15	2.800	-0.00005	1.13400	
16	3.000	0.00000	0.93400	
17	3.200	0.00000	0.73400	
18	3.400	0.00005	0.53400	
19	3.600	0.00010	0.33400	
20	3.800	0.00010	0.13400	
21	4.000	0.00000	-0.06600	
22	4.200	0.00000	-0.26600	
23	4.400	-0.00005	-0.46600	
24	4.600	-0.00005	-0.66600	
25	4.800	-0.00010	-0.86600	
26	5.000	-0.00010	-1.06600	
27	5.200	-0.00010	-1.26600	
28	5.400	-0.00005	-1.46600	
29	5.600	-0.00005	-1.66600	
30	5.800	-0.00005	-1.86600	
31	6.000	-0.00005	-2.06600	
32	6.200	0.00000	-2.26600	
33	6.400	0.00000	-2.46600	
34	6.600	0.00000	-2.66600	
35	6.800	0.00010	-2.86600	
36	7.000	0.00015	-3.06600	
37	7.200	0.00020	-3.26600	
38	7.400	0.00030	-3.46600	

SHOT No. ____415 _____
SAMPLE CAPSULE: ___7_____
SAMPLE MATERIAL: Fayalite

tip used: .7mm long/ flat tip
note: the platform on which the measurement was taken deviates from flat by +0.013 max.
direction of measurement

4.618
4.661

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = -0.00003

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = 0.00011

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = 0.00050

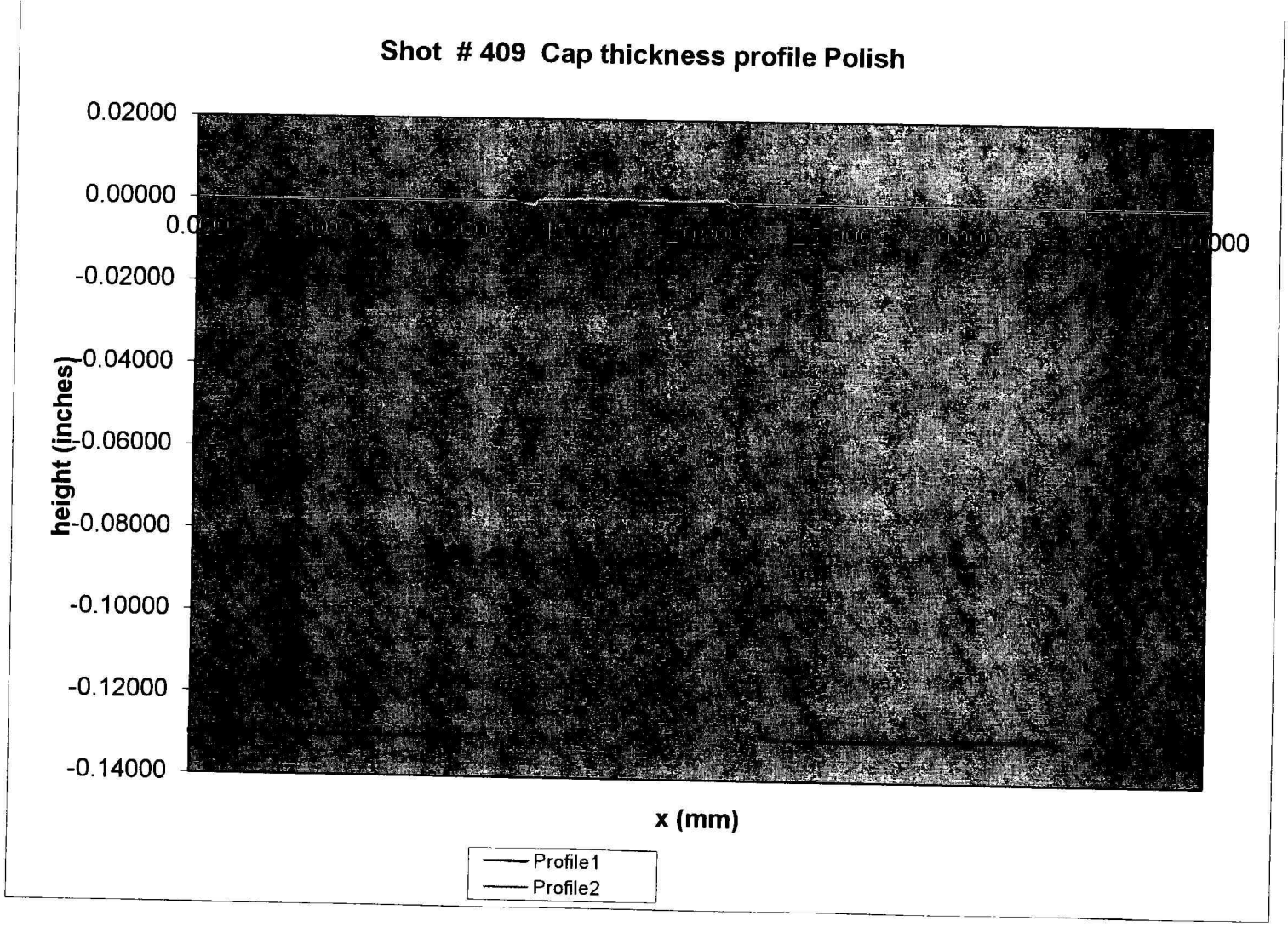
Note: Measurement from reference zero point from the base is = 0.1761 Inches
4.4722 mm

Average thickness of the driver Plate = 0.0460 Inches
1.1689 mm

Thickness of the Carbon Deposited on the coil side is = 89.5 **nm**

Thickness of the Carbon Deposited on the Projectile side is = 97.4 **nm**

Distance from the top of the cap to the measured (avg) driver plate **0.13** Inches
3.30 mm


Shot # 409 Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
height (inches)
x (mm)
Profile1
Profile2

1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading	Reading Distance mm
1	0.000	17.000	-0.1301	225	22.400	-5.400	-0.1255	118	11.700
2	0.100	16.900	-0.1300	226	22.500	-5.500	-0.1282	119	11.800
3	0.200	16.800	-0.1299	227	22.600	-5.600	-0.1299	120	11.900
4	0.300	16.700	-0.1299	228	22.700	-5.700	-0.1300	121	12.000
5	0.400	16.600	-0.1298	229	22.800	-5.800	-0.1300	122	12.100
6	0.500	16.500	-0.1299	230	22.900	-5.900	-0.1300	123	12.200
7	0.600	16.400	-0.1298	231	23.000	-6.000	-0.1300	124	12.300
8	0.700	16.300	-0.1298	232	23.100	-6.100	-0.1300	125	12.400
9	0.800	16.200	-0.1298	233	23.200	-6.200	-0.1299	126	12.500
10	0.900	16.100	-0.1298	234	23.300	-6.300	-0.1300	127	12.600
11	1.000	16.000	-0.1298	235	23.400	-6.400	-0.1301	128	12.700
12	1.100	15.900	-0.1298	236	23.500	-6.500	-0.1301	129	12.800
13	1.200	15.800	-0.1298	237	23.600	-6.600	-0.1301	130	12.900
14	1.300	15.700	-0.1298	238	23.700	-6.700	-0.1301	131	13.000
15	1.400	15.600	-0.1298	239	23.800	-6.800	-0.1301	132	13.100
16	1.500	15.500	-0.1298	240	23.900	-6.900	-0.1301	133	13.200
17	1.600	15.400	-0.1298	241	24.000	-7.000	-0.1302	134	13.300
18	1.700	15.300	-0.1298	242	24.100	-7.100	-0.1301	135	13.400
19	1.800	15.200	-0.1299	243	24.200	-7.200	-0.1301	136	13.500
20	1.900	15.100	-0.1298	244	24.300	-7.300	-0.1301	137	13.600
21	2.000	15.000	-0.1299	245	24.400	-7.400	-0.1301	138	13.700
22	2.100	14.900	-0.1299	246	24.500	-7.500	-0.1302	139	13.800
23	2.200	14.800	-0.1299	247	24.600	-7.600	-0.1302	140	13.900
24	2.300	14.700	-0.1299	248	24.700	-7.700	-0.1302	141	14.000
25	2.400	14.600	-0.1299	249	24.800	-7.800	-0.1302	142	14.100
26	2.500	14.500	-0.1299	250	24.900	-7.900	-0.1302	143	14.200
27	2.600	14.400	-0.1299	251	25.000	-8.000	-0.1303	144	14.300
28	2.700	14.300	-0.1300	252	25.100	-8.100	-0.1302	145	14.400
29	2.800	14.200	-0.1300	253	25.200	-8.200	-0.1302	146	14.500
30	2.900	14.100	-0.1300	254	25.300	-8.300	-0.1303	147	14.600
31	3.000	14.000	-0.1300	255	25.400	-8.400	-0.1302	148	14.700
32	3.100	13.900	-0.1300	256	25.500	-8.500	-0.1303	149	14.800
33	3.200	13.800	-0.1300	257	25.600	-8.600	-0.1303	150	14.900
34	3.300	13.700	-0.1300	258	25.700	-8.700	-0.1303	151	15.000
35	3.400	13.600	-0.1301	259	25.800	-8.800	-0.1302	152	15.100
36	3.500	13.500	-0.1301	260	25.900	-8.900	-0.1302	153	15.200
37	3.600	13.400	-0.1301	261	26.000	-9.000	-0.1302	154	15.300
38	3.700	13.300	-0.1301	262	26.100	-9.100	-0.1302	155	15.400
39	3.800	13.200	-0.1301	263	26.200	-9.200	-0.1302	156	15.500
40	3.900	13.100	-0.1301	264	26.300	-9.300	-0.1302	157	15.600
41	4.000	13.000	-0.1301	265	26.400	-9.400	-0.1302	158	15.700
42	4.100	12.900	-0.1301	266	26.500	-9.500	-0.1302	159	15.800
43	4.200	12.800	-0.1302	267	26.600	-9.600	-0.1302	160	15.900
44	4.300	12.700	-0.1302	268	26.700	-9.700	-0.1302	161	16.000
45	4.400	12.600	-0.1302	269	26.800	-9.800	-0.1302	162	16.100
46	4.500	12.500	-0.1302	270	26.900	-9.900	-0.1302	163	16.200
47	4.600	12.400	-0.1302	271	27.000	-10.000	-0.1302	164	16.300
48	4.700	12.300	-0.1302	272	27.100	-10.100	-0.1302	165	16.400
49	4.800	12.200	-0.1302	273	27.200	-10.200	-0.1302	166	16.500
50	4.900	12.100	-0.1302	274	27.300	-10.300	-0.1303	167	16.600
51	5.000	12.000	-0.1302	275	27.400	-10.400	-0.1302	168	16.700

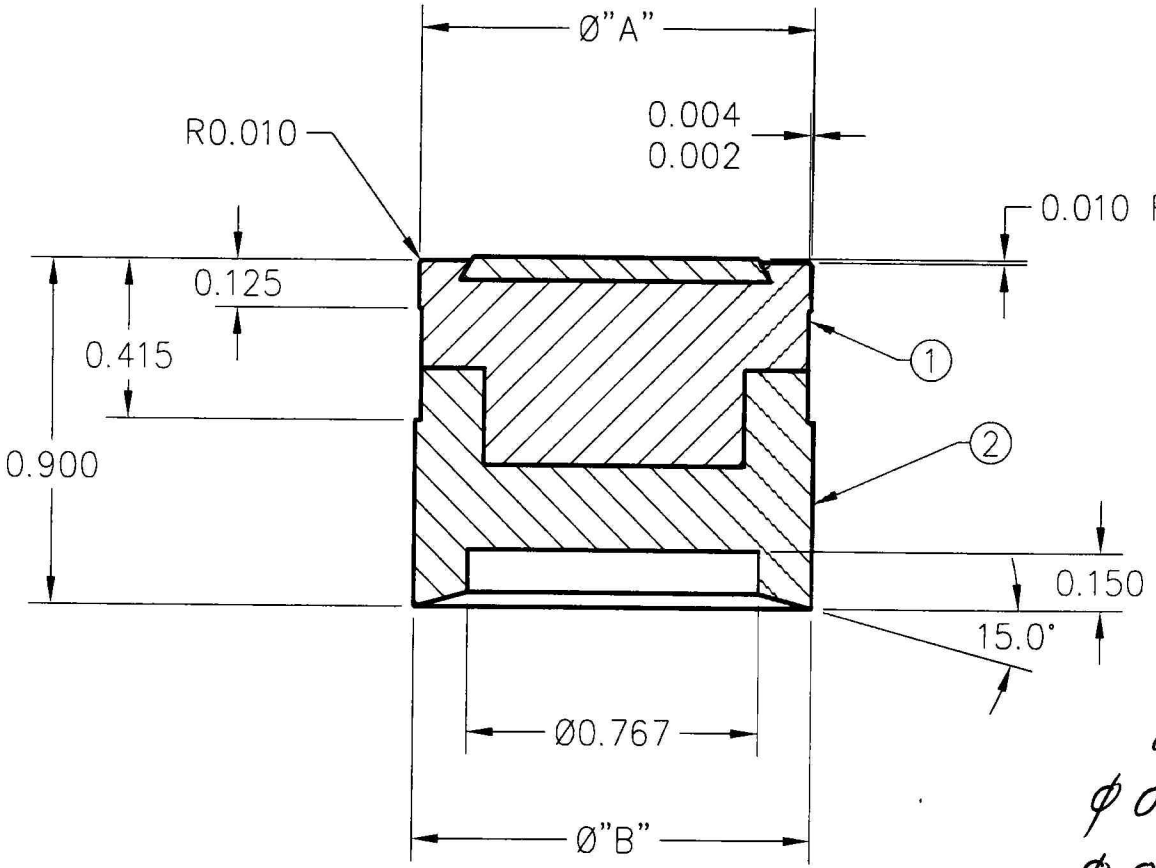
52	5.100	11.900	-0.1303	276	27.500	-10.500	-0.1302	169	16.800
53	5.200	11.800	-0.1302	277	27.600	-10.600	-0.1302	170	16.900
54	5.300	11.700	-0.1302	278	27.700	-10.700	-0.1302	171	17.000
55	5.400	11.600	-0.1302	279	27.800	-10.800	-0.1302	172	17.100
56	5.500	11.500	-0.1302	280	27.900	-10.900	-0.1302	173	17.200
57	5.600	11.400	-0.1303	281	28.000	-11.000	-0.1302	174	17.300
58	5.700	11.300	-0.1302	282	28.100	-11.100	-0.1302	175	17.400
59	5.800	11.200	-0.1302	283	28.200	-11.200	-0.1302	176	17.500
60	5.900	11.100	-0.1302	284	28.300	-11.300	-0.1301	177	17.600
61	6.000	11.000	-0.1303	285	28.400	-11.400	-0.1301	178	17.700
62	6.100	10.900	-0.1303	286	28.500	-11.500	-0.1302	179	17.800
63	6.200	10.800	-0.1303	287	28.600	-11.600	-0.1301	180	17.900
64	6.300	10.700	-0.1303	288	28.700	-11.700	-0.1302	181	18.000
65	6.400	10.600	-0.1304	289	28.800	-11.800	-0.1301	182	18.100
66	6.500	10.500	-0.1303	290	28.900	-11.900	-0.1301	183	18.200
67	6.600	10.400	-0.1303	291	29.000	-12.000	-0.1301	184	18.300
68	6.700	10.300	-0.1303	292	29.100	-12.100	-0.1301	185	18.400
69	6.800	10.200	-0.1304	293	29.200	-12.200	-0.1301	186	18.500
70	6.900	10.100	-0.1303	294	29.300	-12.300	-0.1301	187	18.600
71	7.000	10.000	-0.1303	295	29.400	-12.400	-0.1301	188	18.700
72	7.100	9.900	-0.1303	296	29.500	-12.500	-0.1301	189	18.800
73	7.200	9.800	-0.1303	297	29.600	-12.600	-0.1300	190	18.900
74	7.300	9.700	-0.1303	298	29.700	-12.700	-0.1301	191	19.000
75	7.400	9.600	-0.1303	299	29.800	-12.800	-0.1300	192	19.100
76	7.500	9.500	-0.1304	300	29.900	-12.900	-0.1300	193	19.200
77	7.600	9.400	-0.1303	301	30.000	-13.000	-0.1300	194	19.300
78	7.700	9.300	-0.1303	302	30.100	-13.100	-0.1300	195	19.400
79	7.800	9.200	-0.1303	303	30.200	-13.200	-0.1300	196	19.500
80	7.900	9.100	-0.1303	304	30.300	-13.300	-0.1300	197	19.600
81	8.000	9.000	-0.1303	305	30.400	-13.400	-0.1300	198	19.700
82	8.100	8.900	-0.1302	306	30.500	-13.500	-0.1300	199	19.800
83	8.200	8.800	-0.1303	307	30.600	-13.600	-0.1300	200	19.900
84	8.300	8.700	-0.1303	308	30.700	-13.700	-0.1300	201	20.000
85	8.400	8.600	-0.1303	309	30.800	-13.800	-0.1299	202	20.100
86	8.500	8.500	-0.1303	310	30.900	-13.900	-0.1299	203	20.200
87	8.600	8.400	-0.1303	311	31.000	-14.000	-0.1299	204	20.300
88	8.700	8.300	-0.1303	312	31.100	-14.100	-0.1298	205	20.400
89	8.800	8.200	-0.1303	313	31.200	-14.200	-0.1299	206	20.500
90	8.900	8.100	-0.1302	314	31.300	-14.300	-0.1299	207	20.600
91	9.000	8.000	-0.1303	315	31.400	-14.400	-0.1299	208	20.700
92	9.100	7.900	-0.1302	316	31.500	-14.500	-0.1299	209	20.800
93	9.200	7.800	-0.1302	317	31.600	-14.600	-0.1299	210	20.900
94	9.300	7.700	-0.1302	318	31.700	-14.700	-0.1299	211	21.000
95	9.400	7.600	-0.1302	319	31.800	-14.800	-0.1299	212	21.100
96	9.500	7.500	-0.1302	320	31.900	-14.900	-0.1298	213	21.200
97	9.600	7.400	-0.1302	321	32.000	-15.000	-0.1298	214	21.300
98	9.700	7.300	-0.1302	322	32.100	-15.100	-0.1298	215	21.400
99	9.800	7.200	-0.1302	323	32.200	-15.200	-0.1298	216	21.500
100	9.900	7.100	-0.1302	324	32.300	-15.300	-0.1297	217	21.600
101	10.000	7.000	-0.1302	325	32.400	-15.400	-0.1297	218	21.700
102	10.100	6.900	-0.1302	326	32.500	-15.500	-0.1297	219	21.800
103	10.200	6.800	-0.1302	327	32.600	-15.600	-0.1297	220	21.900
104	10.300	6.700	-0.1302	328	32.700	-15.700	-0.1297	221	22.000
105	10.400	6.600	-0.1302	329	32.800	-15.800	-0.1297	222	22.100
106	10.500	6.500	-0.1302	330	32.900	-15.900	-0.1297	223	22.200
107	10.600	6.400	-0.1302	331	33.000	-16.000	-0.1297	224	22.300
108	10.700	6.300	-0.1301	332	33.100	-16.100	-0.1297		
109	10.800	6.200	-0.1301	333	33.200	-16.200	-0.1297		
110	10.900	6.100	-0.1302	334	33.300	-16.300	-0.1297		

111	11.000	6.000	-0.1302	335	33.400	-16.400	-0.1297
112	11.100	5.900	-0.1300	336	33.500	-16.500	-0.1298
113	11.200	5.800	-0.1300	337	33.600	-16.600	-0.1299
114	11.300	5.700	-0.1300	338	33.700	-16.700	-0.1299
115	11.400	5.600	-0.1301	339	33.800	-16.800	-0.1300
116	11.500	5.500	-0.1295	340	33.900	-16.900	-0.1302
117	11.600	5.400	-0.1279	341	34.000	-17.000	-0.1304

0.002677

	1st	2nd	3 rd
abs dist.	Run	Run	Run
	Reading	Reading	Reading
mm	Inches	Inches	Inches
5.300			
5.200			
5.100			
5.000			
4.900			
4.800			
4.700	-0.00028		
4.600	-0.00039		
4.500	-0.00071	-0.00141	
4.400	-0.00017	-0.00112	
4.300	0.00017	-0.00113	
4.200	0.00021	-0.00079	
4.100	0.00019	-0.00011	-0.00056
4.000	0.00028	0.00008	-0.00052
3.900	0.00027	0.00012	-0.00078
3.800	0.00031	0.00021	-0.00099
3.700	0.00029	0.00019	-0.00091
3.600	0.00033	0.00028	0.00023
3.500	0.00032	0.00027	0.00027
3.400	0.00030	0.00025	0.00030
3.300	0.00029	0.00029	0.00039
3.200	0.00033	0.00033	0.00043
3.100	0.00032	0.00037	0.00052
3.000	0.00030	0.00035	0.00050
2.900	0.00024	0.00029	0.00044
2.800	0.00023	0.00028	0.00048
2.700	0.00026	0.00036	0.00056
2.600	0.00025	0.00035	0.00055
2.500	0.00024	0.00034	0.00059
2.400	0.00027	0.00037	0.00062
2.300	0.00021	0.00031	0.00056
2.200	0.00020	0.00030	0.00060
2.100	0.00019	0.00034	0.00064
2.000	0.00022	0.00037	0.00072
1.900	0.00021	0.00036	0.00071
1.800	0.00015	0.00025	0.00060
1.700	0.00013	0.00028	0.00063
1.600	0.00022	0.00037	0.00072
1.500	0.00021	0.00036	0.00081
1.400	0.00014	0.00029	0.00069
1.300	0.00013	0.00028	0.00068
1.200	0.00017	0.00032	0.00067
1.100	0.00015	0.00030	0.00075
1.000	0.00014	0.00029	0.00064
0.900	0.00007	0.00022	0.00052
0.800	0.00016	0.00031	0.00066
0.700	0.00005	0.00020	0.00055
0.600	0.00008	0.00023	0.00058
0.500	0.00012	0.00027	0.00062
0.400	0.00011	0.00031	0.00071
0.300	0.00009	0.00029	0.00069

0.200	-0.00002	0.00018	0.00058
0.100	0.00001	0.00026	0.00076
0.000	0.00000	0.00030	0.00080
-0.100	-0.00001	0.00014	0.00064
-0.200	0.00002	0.00017	0.00067
-0.300	-0.00004	0.00011	0.00061
-0.400	-0.00006	0.00009	0.00059
-0.500	-0.00007	0.00008	0.00058
-0.600	-0.00003	0.00012	0.00062
-0.700	-0.00005	0.00015	0.00060
-0.800	-0.00006	0.00014	0.00064
-0.900	-0.00008	0.00012	0.00062
-1.000	-0.00004	0.00021	0.00071
-1.100	-0.00011	0.00014	0.00064
-1.200	-0.00007	0.00018	0.00068
-1.300	-0.00014	0.00011	0.00061
-1.400	-0.00015	0.00010	0.00070
-1.500	-0.00016	0.00009	0.00064
-1.600	-0.00018	0.00007	0.00062
-1.700	-0.00019	0.00006	0.00061
-1.800	-0.00016	0.00009	0.00064
-1.900	-0.00017	0.00008	0.00063
-2.000	-0.00024	0.00001	0.00056
-2.100	-0.00025	0.00000	0.00060
-2.200	-0.00027	-0.00002	0.00053
-2.300	-0.00018	0.00007	0.00057
-2.400	-0.00025	0.00000	0.00055
-2.500	-0.00026	-0.00001	0.00054
-2.600	-0.00028	0.00002	0.00052
-2.700	-0.00029	-0.00004	0.00051
-2.800	-0.00031	-0.00001	0.00059
-2.900	-0.00032	-0.00007	0.00068
-3.000	-0.00034	-0.00009	0.00071
-3.100	-0.00035	-0.00010	0.00070
-3.200	-0.00032	-0.00007	0.00073
-3.300	-0.00038	-0.00008	0.00067
-3.400	-0.00035	0.00010	0.00080
-3.500	-0.00026	0.00029	0.00074
-3.600	-0.00018	0.00047	0.00077
-3.700	-0.00004	0.00071	0.00076
-3.800	0.00009	0.00084	0.00114
-3.900	0.00013	0.00083	0.00048
-4.000	0.00011	0.00051	0.00031
-4.100	-0.00006	0.00019	0.00014
-4.200	-0.00027	-0.00027	-0.00022
-4.300	-0.00049	-0.00079	-0.00079
-4.400	-0.00065	-0.00070	
-4.500	-0.00077	-0.00067	
-4.600	-0.00048	-0.00048	
-4.700	-0.00045		
-4.800	-0.00071		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			0.00000



as built
ϕ 0.9798
ϕ 0.9905

0.0614" Ta 10/14/10

SHOT# 41[illegible]65		
A	0.9800	+.0000 −.0005
B	0.9905	+.0005 −.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−048	1
1	Sabot & Flyer Plate	LGG−049	1

Note: Super Glue & Press Fit 1 & 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN	DATE
M. Long	1/23/04
ENGINEER	DATE
APPROVED	DATE

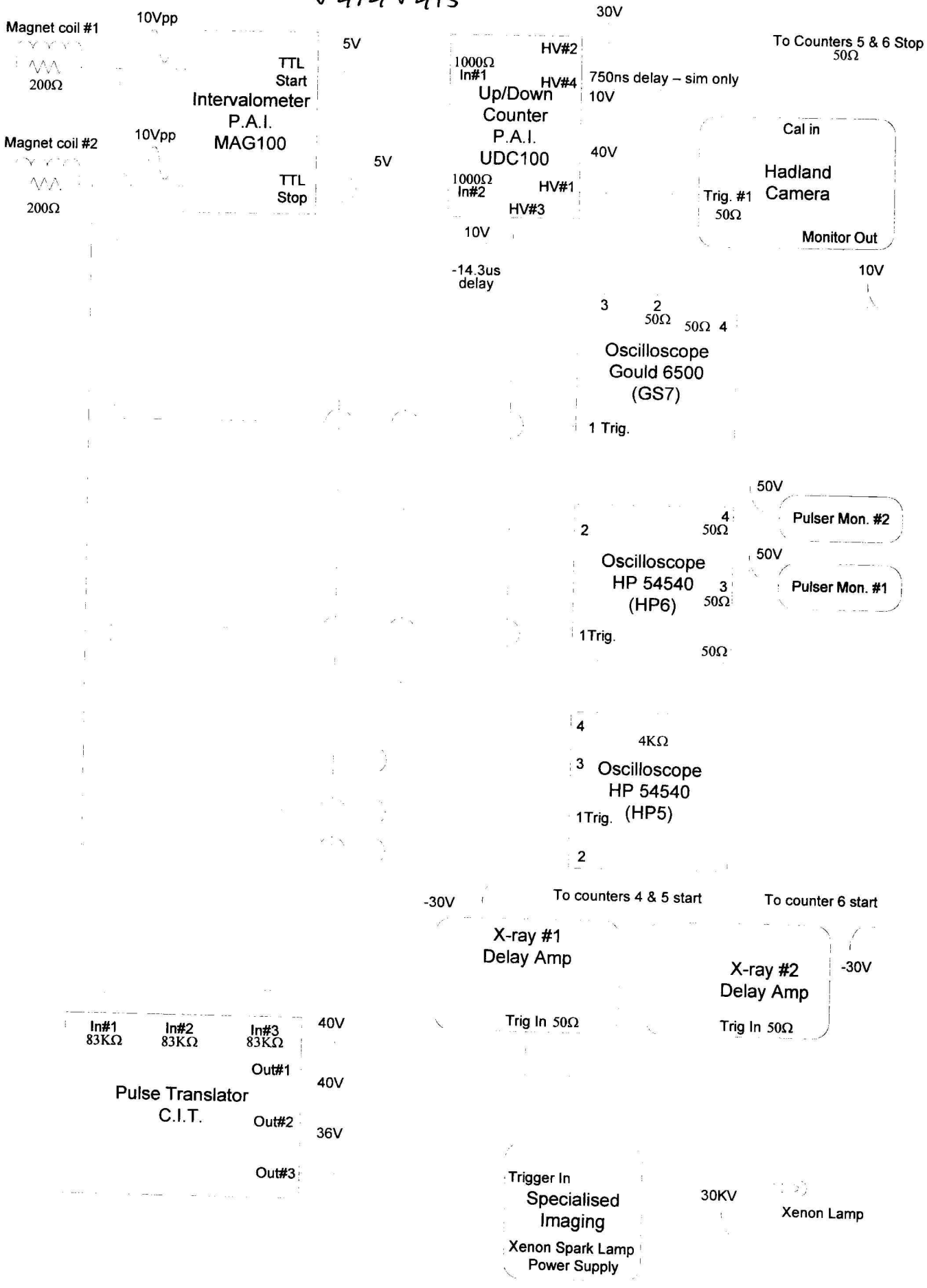
CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy.

FINISH	MATERIAL	SCALE	SHEET		DRAWING NUMBER
16	Zelux−M&HDP	2:1	2 of 2	A	LGG−050

Shot #413 Scope Schematic

+414 +415



Shot 415 Nominal Timeline Preshot

V	5600	
cable time	90	150
tervalometer intrinsic delay	[redacted]	
UDC extra count lag	[redacted]	
pulse translator delay	150	
X-ray 1 program delay	[redacted]	
X-ray 2 program delay	[redacted]	
X-ray 1 pulser delay	600	
X-ray 2 pulser delay	[redacted]	
Camera intrinsic delay	107	
Streak duration	1514	
:d dead streak before driver	600	

2670	X-ray 1 actual delay
71030	X-ray 2 actual delay

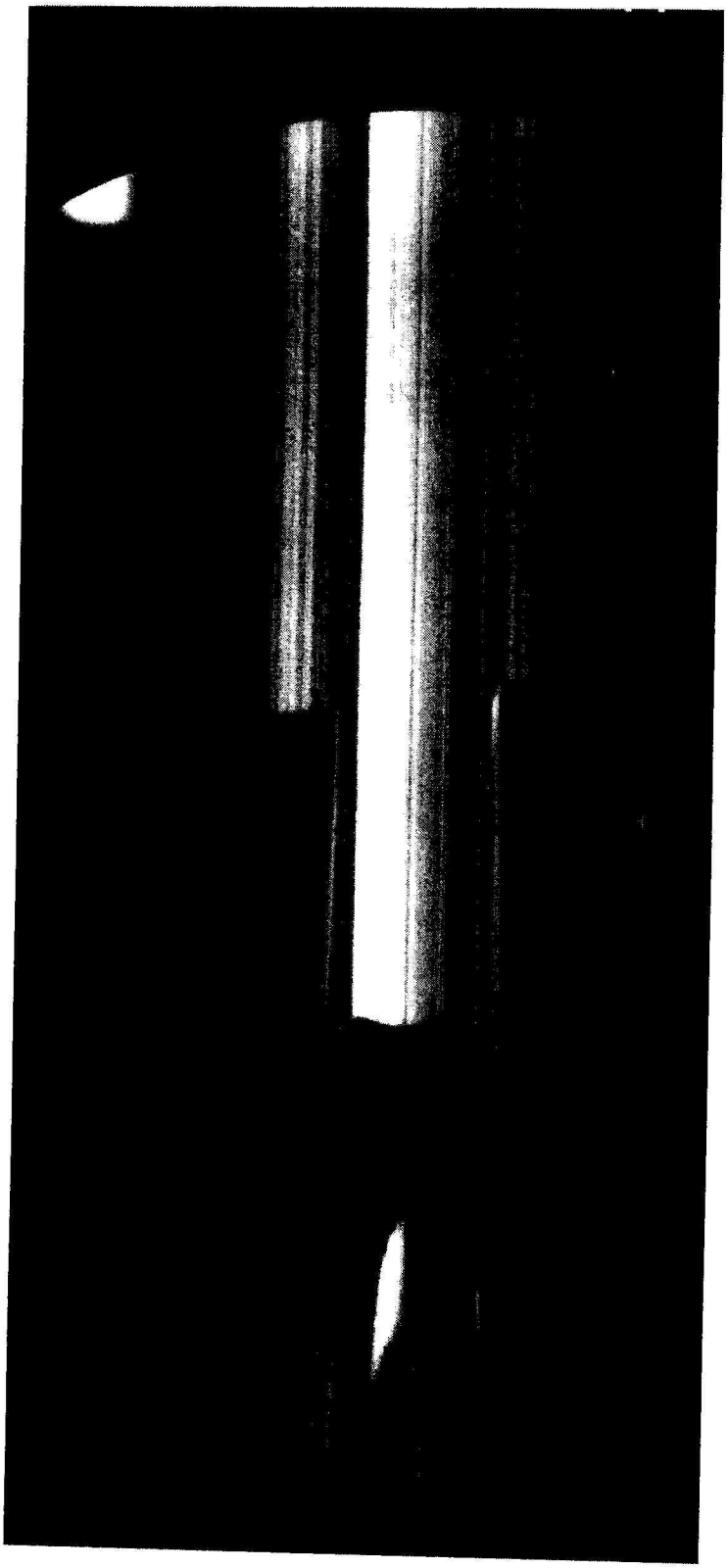
M1-M2 distance	0.203606
M2-target distance	0.217881
M2-target fudge	[redacted]
M1-fid1 distance	0.03
M1-fid2 distance	0.383145
Flyer thickness	0.00156
Us(Mo)	8913.4484
driver thickness	0.001169
estimated sample+cover time	400

t (ns)	flyer x (m)	shock front (m)	event
0	0.00078		M1 zero-crossing
150	0.00162		HP5-1, GS7-1, Intervalometer start
2230	0.013268		HP5-3, UDC start, signal to pulse translator
2380	0.014108		pulse translator out, GS7 trig
5050	0.02906		X-ray 1 delay amp out to counters 4, 5
5740	0.032924		X-ray 1 fires
5830	0.033428		X-ray 1 pulse monitor at counter 4b
36358	0.204386		M2 zero-crossing
36508	0.205226		HP5-2, Intervalometer stop
38588	0.216874		HP5-4, UDC stop
73410	0.411876		X-ray 2 delay amp, stop counter 4, start counter 6
74125	0.41588		X-ray 2 fires
74215	0.416384		X-ray 2 pulse monitor at counter 4b
74460	0.41775824		UDC out, GS7-3, stop counters 5 and 6
74550	0.41826224		Trigger at camera
74657	0.41886144		Begin Streak
74747	0.41936544		Camera Monitor on GS7-4
75126	0.421487	0	IMPACT
75257		0.001169	Driver arrival on streak
75657		0.004734379	Sample cutoff on streak
76171		0.009315892	End Streak

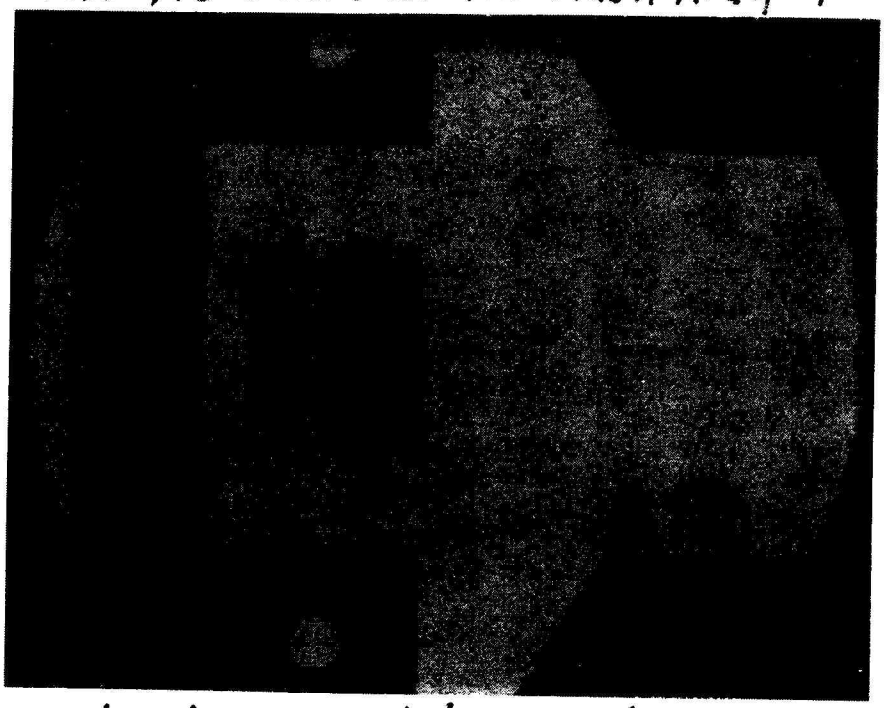
		X-ray velocity	5600
			On film
X-ray 1 flyer vs. fid (mm)		2.924	3.4
Counter 3:	36358		
		HP5 2-1	36358
UDC upcount:	36358	HP5 4-3	36358
Counter 4:	68360		
X-ray 2 flyer vs. fid (mm)		32.735	38.0639535
Counter 4b:	68385		
Counter 5:	69410	GS7 3-1	74310
Counter 6:	1050	GS7 4-1	74597

Driver cutoff on streak	600
Sample cutoff on sreak	1000

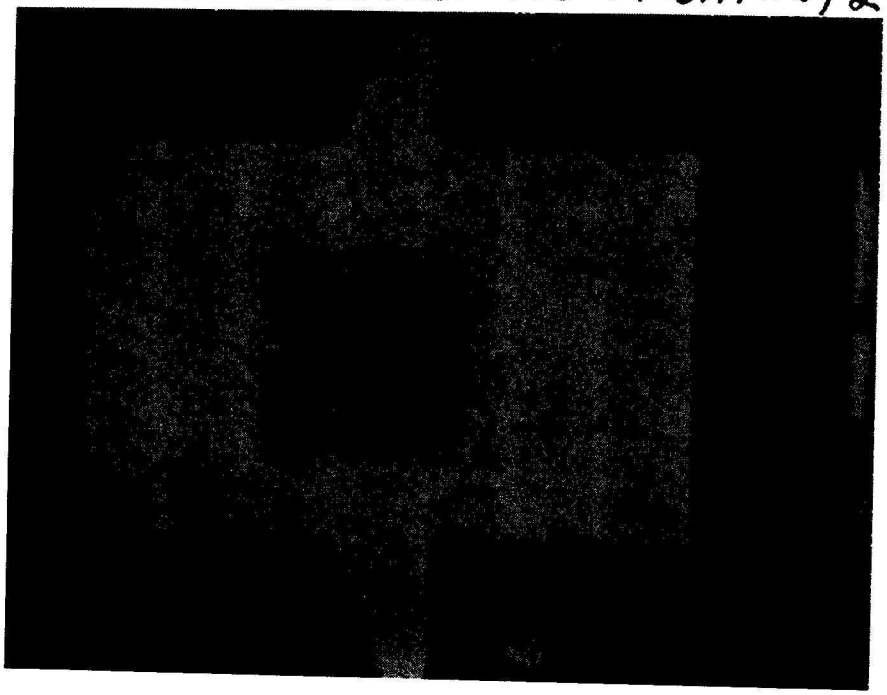
415 Shot



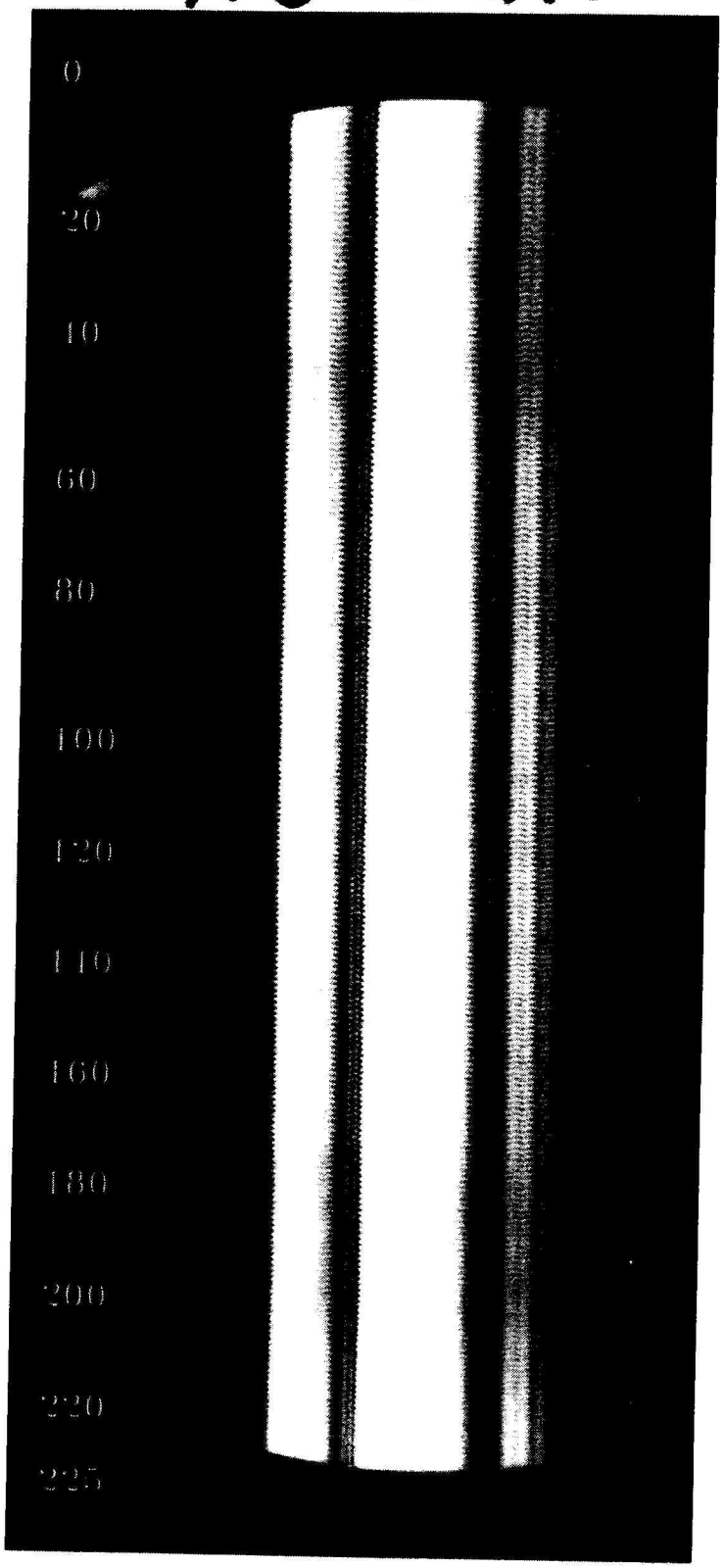
10/26/10 LGG Shot 415 Flash Xray #1



10/26/10 LGG Shot 415 Flash Xray #2

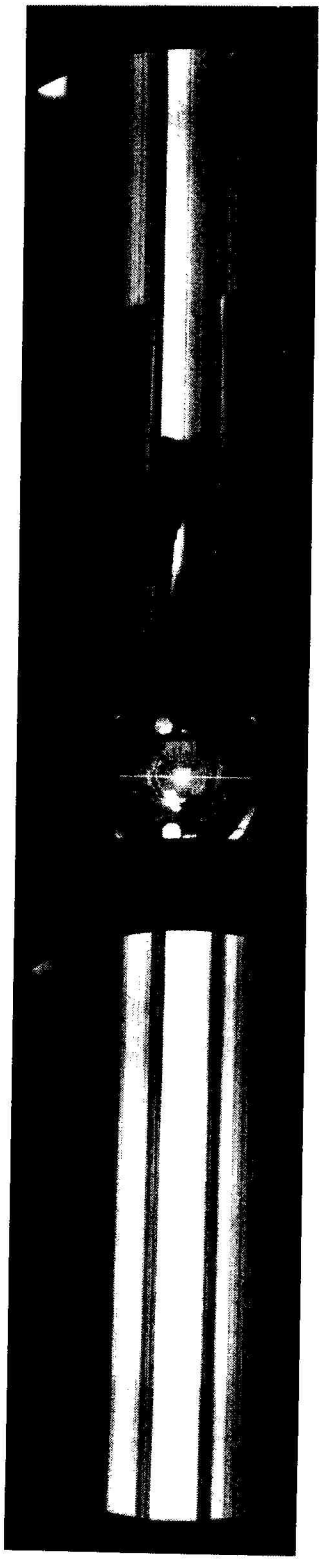


415 Cal.

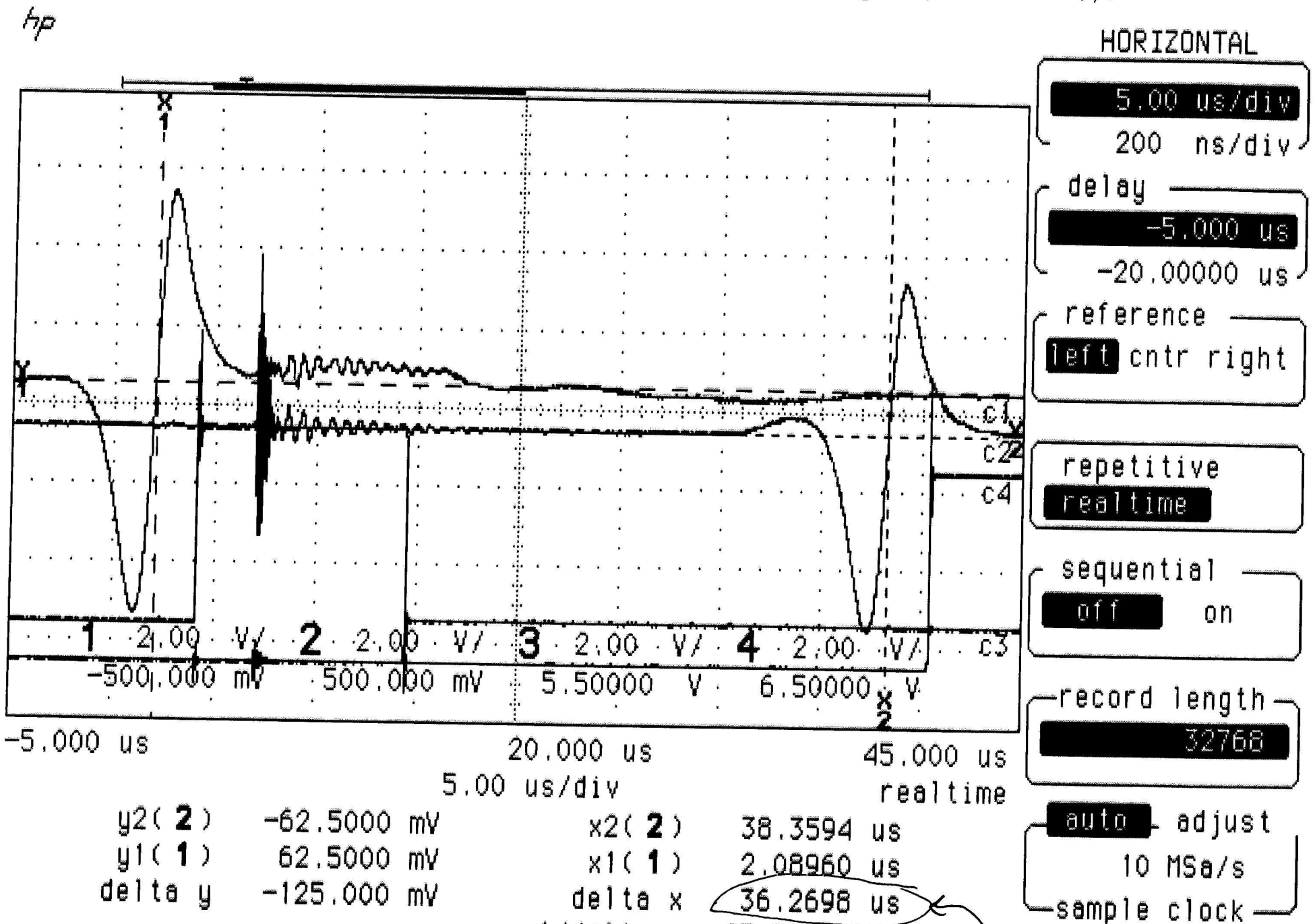


225 x 6.757ns = 1520ns

415 Shot



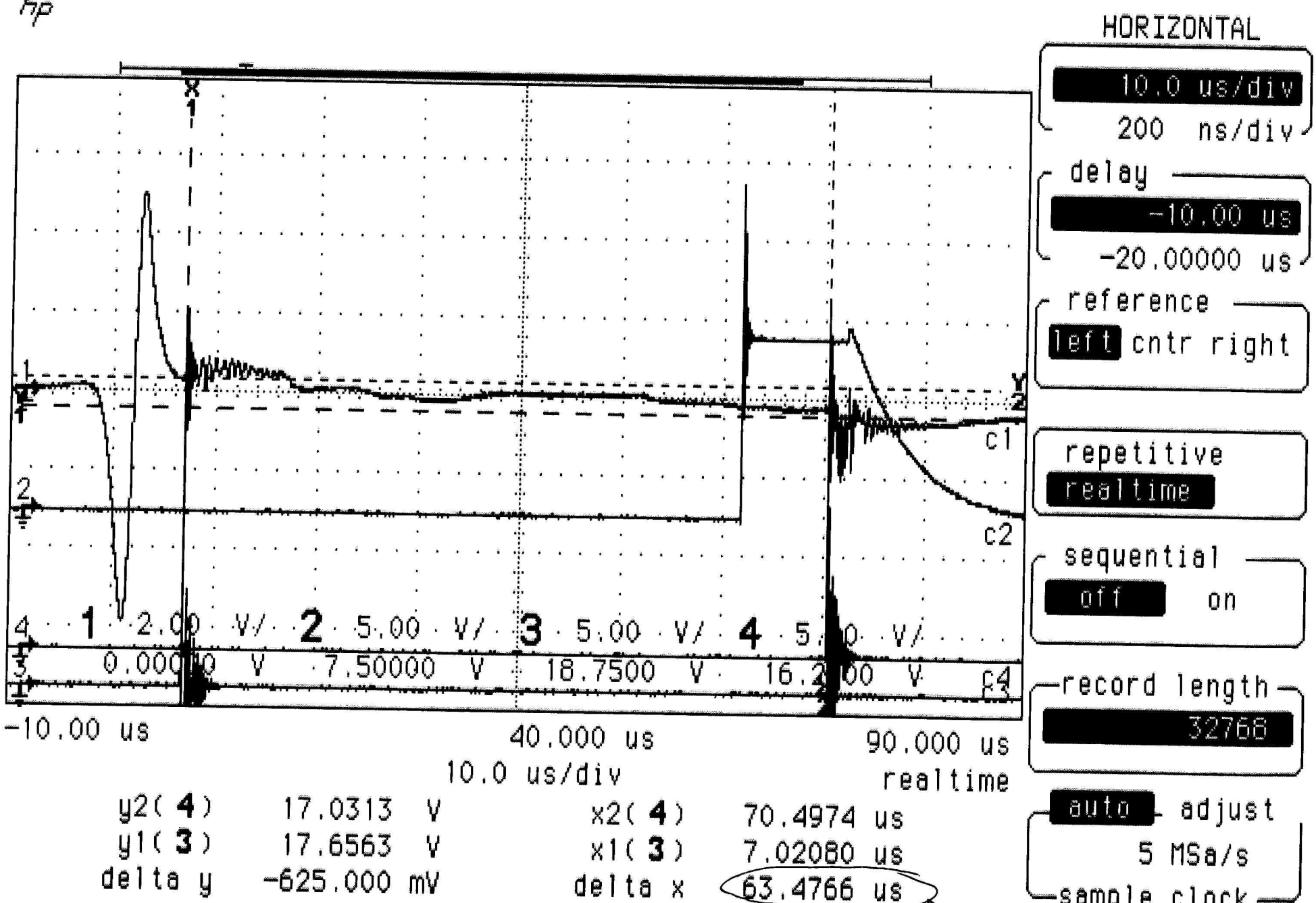
Shot 415 HPS



Velocity Magnet 1 to 2 interval

Shot 415 HP6

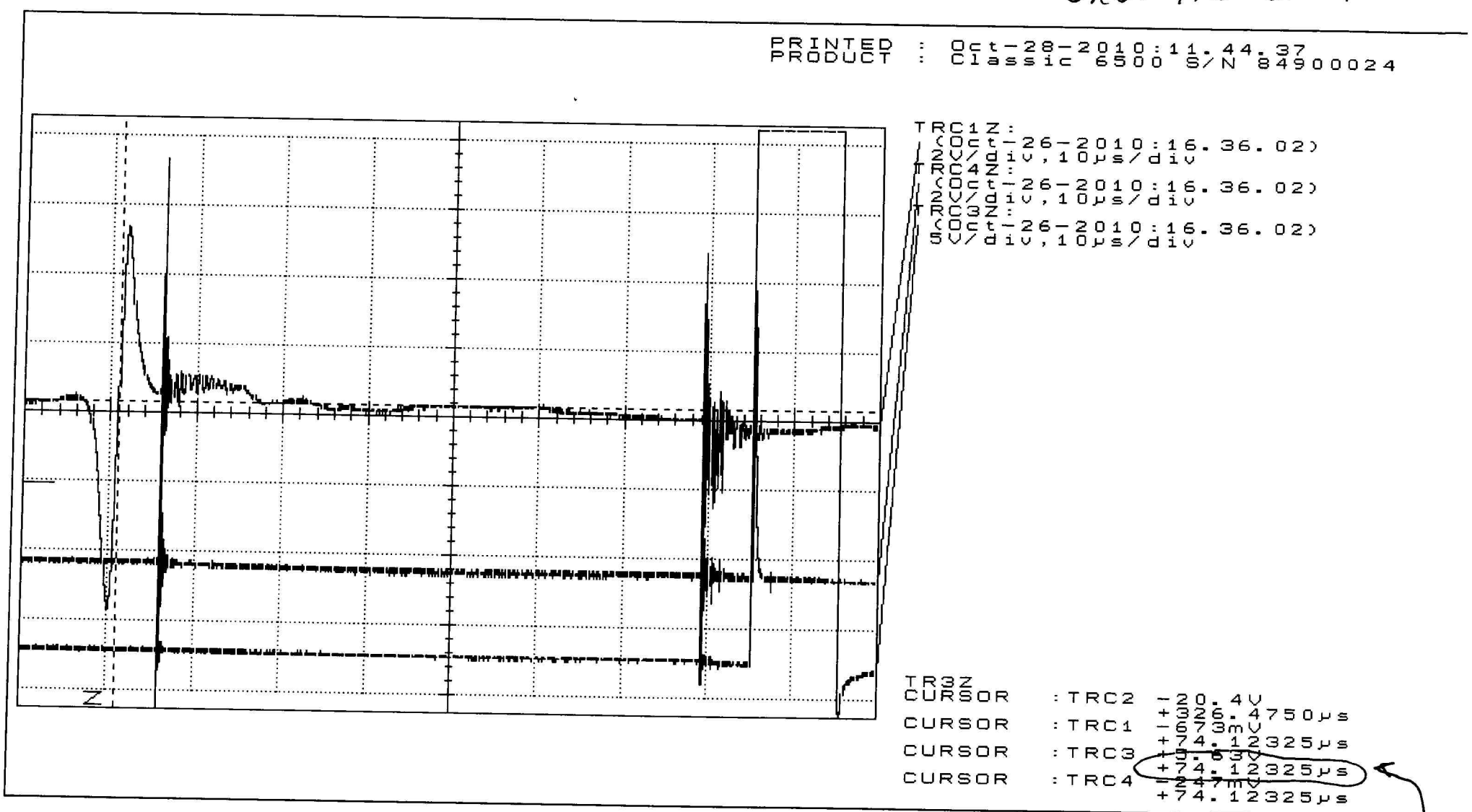
hp



y2(4)	17.0313 V	x2(4)	70.4974 us
y1(3)	17.6563 V	x1(3)	7.02080 us
delta y	-625.000 mV	delta x	63.4766 us
		1/delta x	15.7538 kHz

X ray pulser 1 to 2 interval

Shot 415 GS7



Velocity magnet 1 to camera trig (UDC HV1) interval

Velocity magnet 1 to camera monitor out = 74.407μs

LIGHT GAS GUN DATA SHEET

Shot No. 416 Date 11/5/10

Target:

Sample Material Hedenbergite #8 Crystallographic orientation _____

Source Location Univ. of Michigan Thickness:1 _____ in.

Type of Measurement EOS - preheated to 1400°C 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in. Material _____

Projectile:

Weight 18.131 gms. Length 0.9080 in. Skirt Diameter 0.9904 in.

Flyer Plate Material Ta Leading Edge Dia. 0.9799 in.

Thickness 0.0612 in. Major Dia. 0.8131 in. Depth Inserted 2 in.

Minor Dia. 0.75 in. Insertion force ~ 100lbs

Barrel Dimensions:

Breech Diameter 0.9874 in. Muzzle Diameter 0.980 in. Taper 0.0074 in.

Ellipticity @ projectile depth insertion point 0.0006 in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth .113 in.

Diameter: Front 3.494 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure −28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 588 gms. Type IMR4350 Total Charge 600 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 5.2 km/sec Piston 0.614 km/sec

Notes: 1399°C at shot time. 4:57 min. heating ramp
7:30 min. total heating time

L.G.G.

Camera Streak Duration: 1527 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.88

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 2.67 µsec Flash X-ray #2 71.03 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0561 in. min.	0.0928 in. min.
0.0567 in. max.	0.0936 in. max

Expected Burst Pressure 4k psi

Instrument Tank/Vacuum Pump Pressure: 75/65 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.98 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.622 km/sec

Piston Velocity from Gauge #1 to #3: 0.618 km/sec

Projectile Velocity from UDC: 5134.27 m/sec

Projectile Velocity from X-ray: _____ km/sec

5150

L.G.G.

COUNTER CONNECTIONS

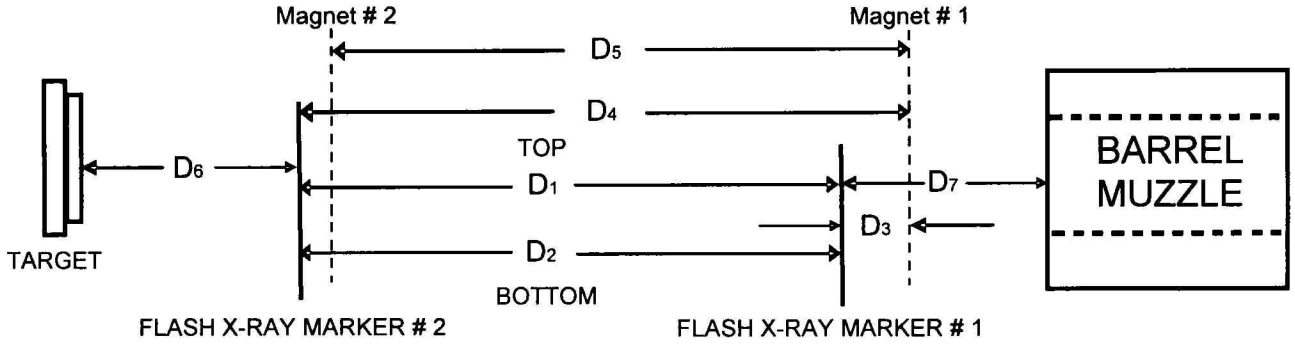
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	490 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	987 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	39.7 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	68.192 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	75.801 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.614 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	68.195 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	39.66 µsec
UDC Velocity:			5134.27 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 ×1 2.081	Velocity magnet 2 ×2 41.7290	39.648 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start ×3 41232	2.042 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop ×4 43.7712	2.042 µsec
HP6, 1-2:	Velocity Magnet 1 ×1 2.0704	Xenon Lamp Trigger ×2 68.5296	66.459 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out ×3 7.444	X-ray 2 Pulser Monitor Out ×4 75.6374	68.193 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	80.776 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	81.059 µsec

TARGET MEASUREMENT

Shot No. **416** Expected Velocity: **5.20** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	39.5	99.0
Measure # 2, mm	30.00	383.15	203.66	40.0	99.0
Average, mm	30.00	383.15	203.61	39.8	99.0
Travel time, µsec	**5.77**	**73.68**	**39.16**	**7.64**	**19.04**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **67.93** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **67.90** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **2.67** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **71.03** µsec.

MAGNET DISTANCE

Shot No. **416** Expected Velocity: **5.20**

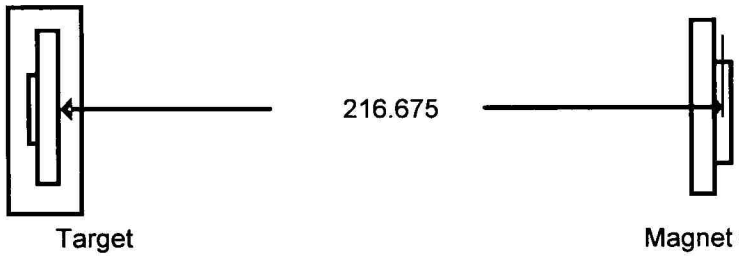
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **39.155 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.405 inch

Second measurement = 8.406 inch

Average measurement = 8.406 inch

Average measurement = 213.500 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 216.675 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **41.668 µsec.**

Fudged Distance between Magnet 2 to Target = 0 mm

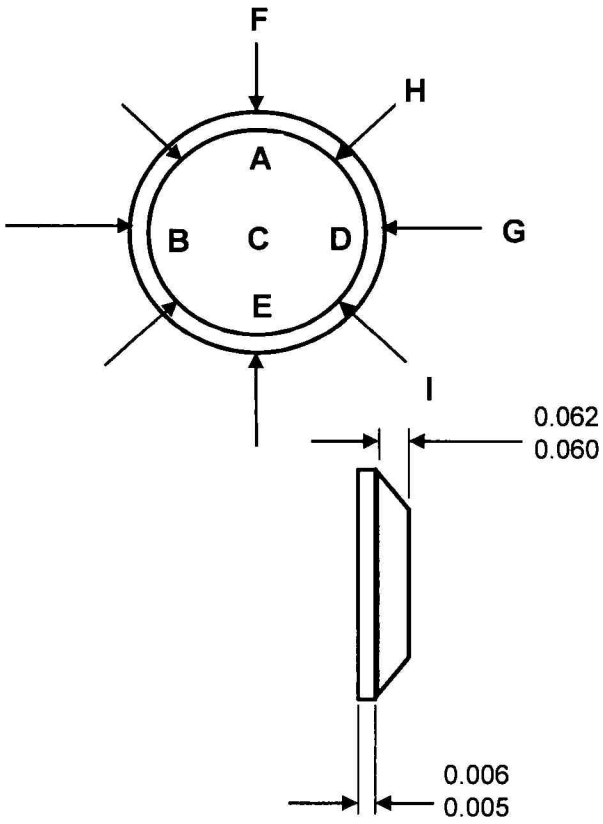
0.200134m

SHOT No.

FLYER PLATE MATERIAL: **Ta # 26** 8/18/2010

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06110	F	0.81300
A	0.06115	F	0.81350
B	0.06110	G	0.81300
B	0.06125	G	0.81300
C	0.06130	H	0.75000
C	0.06125	H	0.75000
D	0.06105	I	0.75000
D	0.06110	I	0.75000
E	0.06100		
E	0.06110		



Statistic for thickness

N	10
MAX	0.06130
MIN	0.06100
Range	0.00030
MEAN	0.061171429 inch
	1.553754286 mm
STDEV	9.5119E-05

Statistic for Diameter (F-G)

N	4
MAX	0.81350
MIN	0.81300
Range	0.00050
MEAN	0.8131250 inch
	20.6533750 mm
STDEV	0.00025

Statistic for Diameter (H-I)

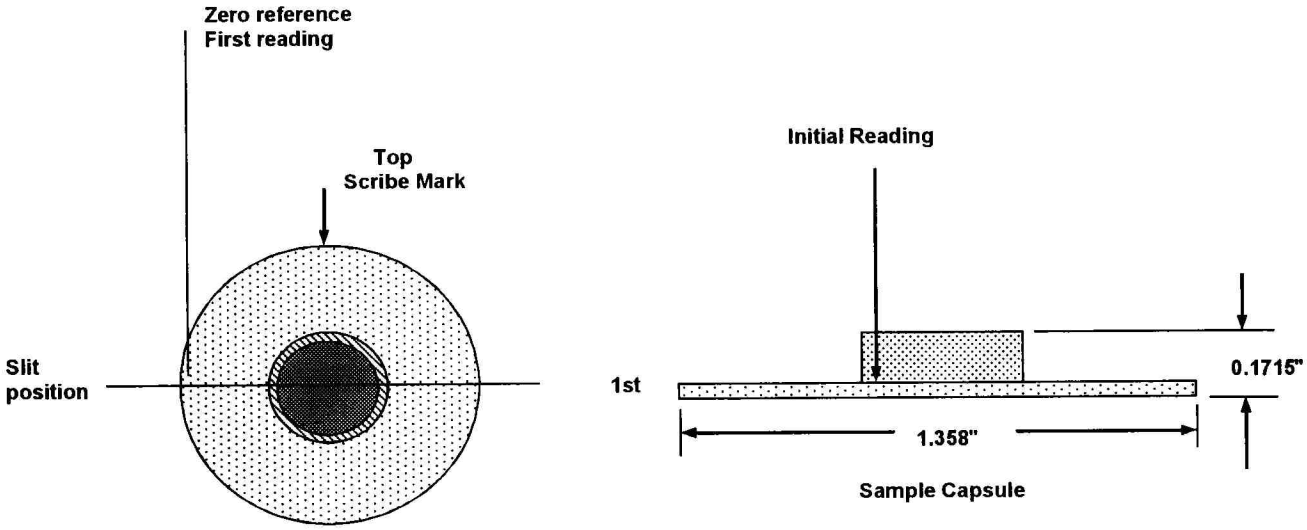
N	4
MAX	0.75000
MIN	0.75000
Range	0.00000
MEAN	0.75 inch
	19.05 mm
STDEV	0

DENSITY MEASUREMENT BY:			Russ	8/12/2010		
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	20.7	1.88249	8.00340	9.47007	0.8650	16.6488
2	20.7	1.88244	8.00339	9.47004	0.8650	16.6499
3	20.7	1.88248	8.0034	9.47000	0.8650	16.6464
	THICKNESS		0.061171429	±	in	
	FLATNESS:		0.00030	in.		
	VOLUME:		0.5205	9.30E-04	cm^3	
	CRYSTAL DENSITY:		16.6484	1.83E-03	$grams/cm^3$	
	BULK DENSITY:		15.3752	9.30E-04	$grams/cm^3$	
	DENSITIES CHECKED BY: _____ on _____					
	MEASUREMENT CHECKED BY: _____ on _____					

SAMPLE CAPSULE 8 6/7/2010
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER # 3

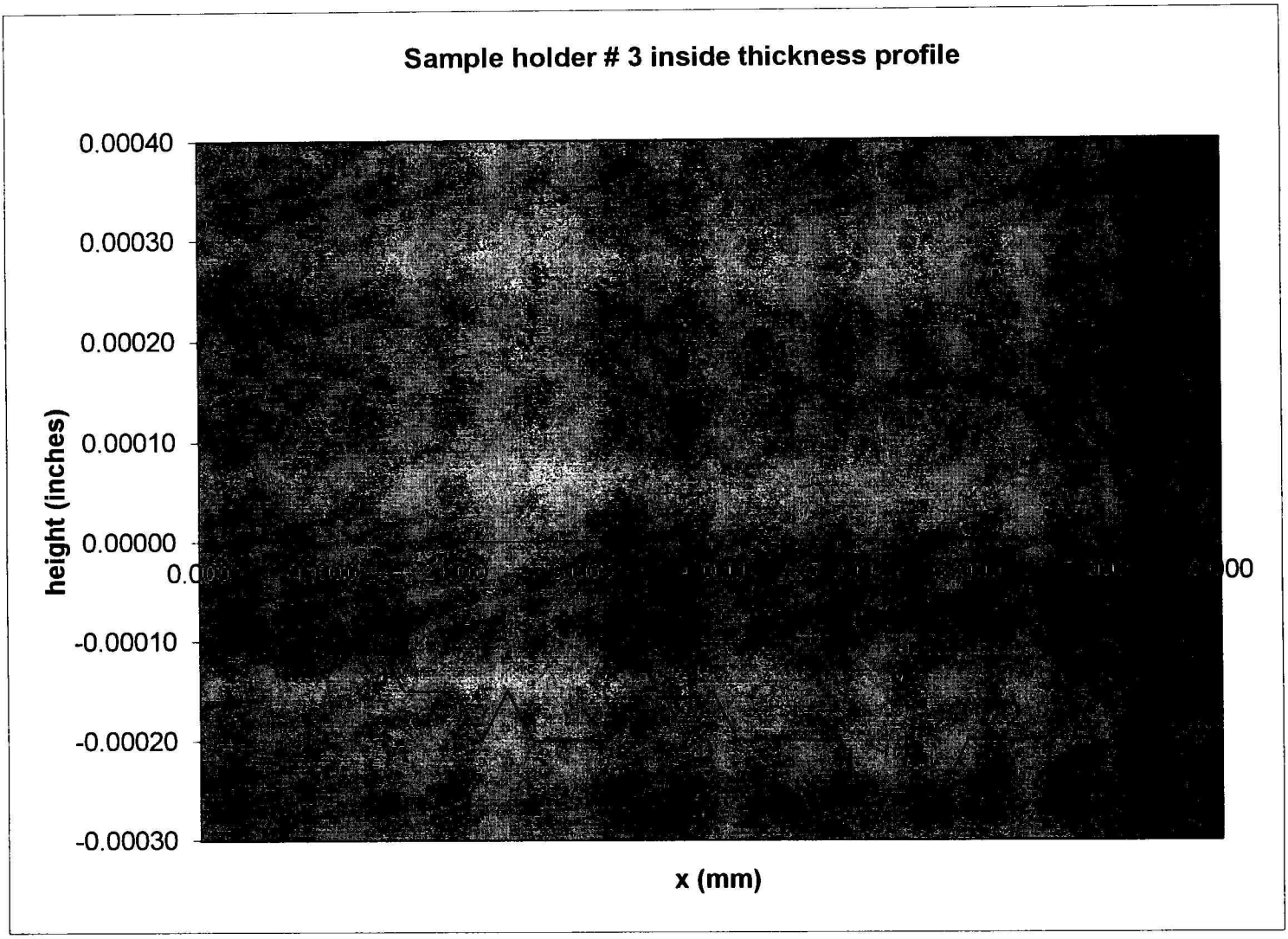
4.47
4.623



1.338582677

Average thickness reading = 0.00008

Note: The thickness of the reference zero point from the base is = 0.04125 Inches
1.04775 mm


Sample holder # 3 inside thickness profile
0.00040
0.00030
0.00020
0.00010
0.00000
-0.00010
-0.00020
-0.00030
height (inches)
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00020	3.528	south
2	0.200	0.00005	3.32800	
3	0.400	-0.00005	3.12800	
4	0.600	0.00000	2.92800	
5	0.800	-0.00005	2.72800	
6	1.000	-0.00005	2.52800	
7	1.200	-0.00010	2.32800	
8	1.400	-0.00010	2.12800	
9	1.600	-0.00015	1.92800	
10	1.800	-0.00015	1.72800	
11	2.000	-0.00015	1.52800	
12	2.200	-0.00020	1.32800	
13	2.400	-0.00015	1.12800	
14	2.600	-0.00020	0.92800	
15	2.800	-0.00020	0.72800	
16	3.000	-0.00020	0.52800	
17	3.200	-0.00020	0.32800	
18	3.400	-0.00015	0.12800	
19	3.600	-0.00015	-0.07200	
20	3.800	-0.00020	-0.27200	
21	4.000	-0.00015	-0.47200	
22	4.200	-0.00020	-0.67200	
23	4.400	-0.00020	-0.87200	
24	4.600	-0.00020	-1.07200	
25	4.800	-0.00020	-1.27200	
26	5.000	-0.00020	-1.47200	
27	5.200	-0.00030	-1.67200	
28	5.400	-0.00025	-1.87200	
29	5.600	-0.00025	-2.07200	
30	5.800	-0.00025	-2.27200	
31	6.000	-0.00020	-2.47200	
32	6.200	-0.00020	-2.67200	
33	6.400	-0.00020	-2.87200	
34	6.600	-0.00020	-3.07200	
35	6.800	-0.00015	-3.27200	
36	7.000	-0.00005	-3.47200	
37	7.200	0.00000	-3.67200	
38	7.400	0.00005	-3.87200	north

SHOT No. ____416_____

SAMPLE CAPSULE: _____8_____

SAMPLE MATERIAL: Hd

tip used: .7mm long/ flat tip

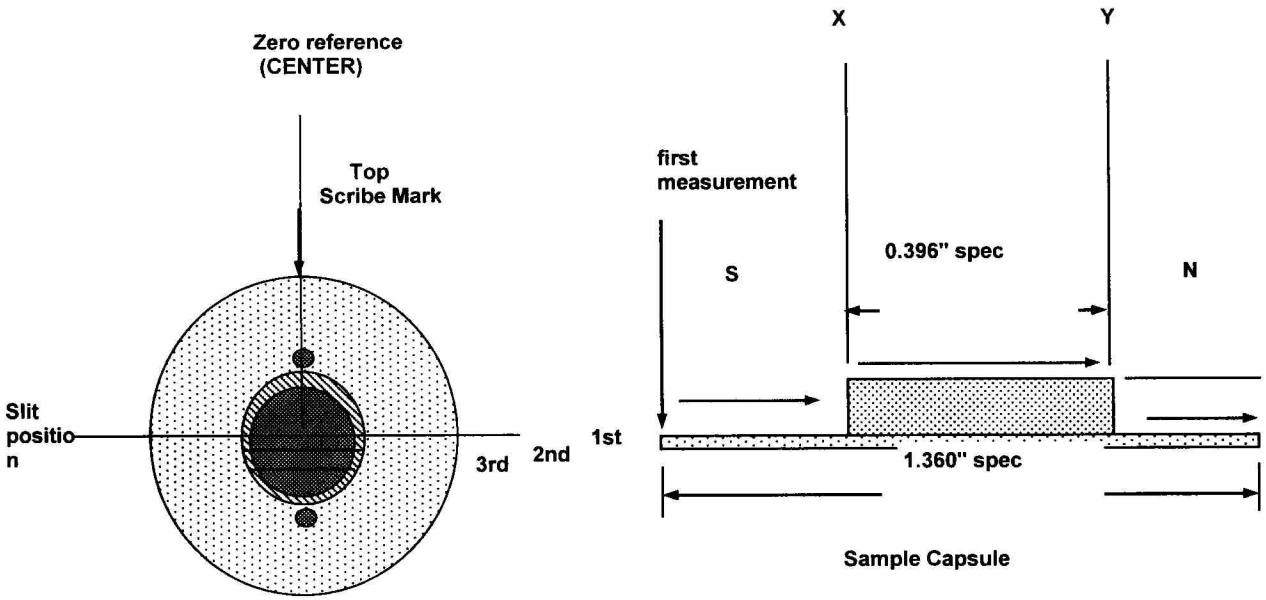
note: the platform on which the measu
deviates from flat by +0.013 max.

direction of measurement

4.997

4.661

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00005

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = -0.00018

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

Average thickness reading = -0.00028

Note: Measurement from reference zero point from the base is = 0.17088

4.3404

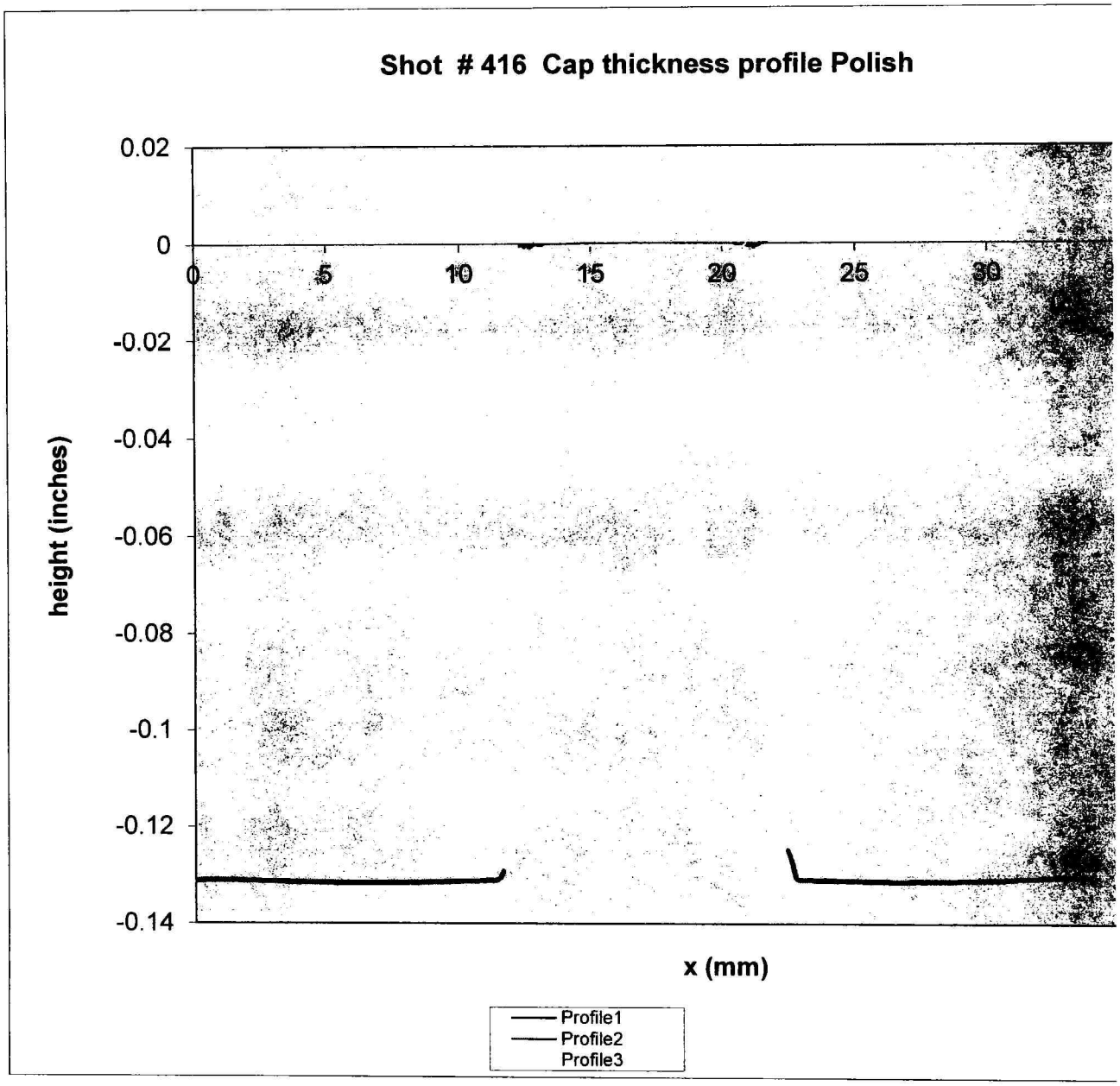
Average thickness of the driver Plate = 0.0398

1.0107

Thickness of the Carbon Deposited on the coil side is =

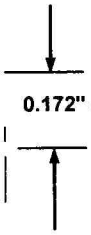
Thickness of the Carbon Deposited on the Projectile side is =

thickness	**0.13**
	3.33



rement was taken

1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**



Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm
1	0.000	17.000	-0.131200	225	22.400	-5.400
2	0.100	16.900	-0.131112	226	22.500	-5.500
3	0.200	16.800	-0.131073	227	22.600	-5.600
4	0.300	16.700	-0.131084	228	22.700	-5.700
5	0.400	16.600	-0.130994	229	22.800	-5.800
6	0.500	16.500	-0.131005	230	22.900	-5.900
7	0.600	16.400	-0.131015	231	23.000	-6.000
8	0.700	16.300	-0.131025	232	23.100	-6.100
9	0.800	16.200	-0.131034	233	23.200	-6.200
10	0.900	16.100	-0.130994	234	23.300	-6.300
11	1.000	16.000	-0.131003	235	23.400	-6.400
12	1.100	15.900	-0.130961	236	23.500	-6.500
13	1.200	15.800	-0.131020	237	23.600	-6.600
14	1.300	15.700	-0.130978	238	23.700	-6.700
15	1.400	15.600	-0.131036	239	23.800	-6.800
16	1.500	15.500	-0.130994	240	23.900	-6.900
17	1.600	15.400	-0.131051	241	24.000	-7.000
18	1.700	15.300	-0.131059	242	24.100	-7.100
19	1.800	15.200	-0.131116	243	24.200	-7.200
20	1.900	15.100	-0.131123	244	24.300	-7.300
21	2.000	15.000	-0.131129	245	24.400	-7.400
22	2.100	14.900	-0.131135	246	24.500	-7.500
23	2.200	14.800	-0.131092	247	24.600	-7.600
24	2.300	14.700	-0.131147	248	24.700	-7.700
25	2.400	14.600	-0.131153	249	24.800	-7.800
26	2.500	14.500	-0.131209	250	24.900	-7.900
27	2.600	14.400	-0.131214	251	25.000	-8.000
28	2.700	14.300	-0.131219	252	25.100	-8.100
29	2.800	14.200	-0.131224	253	25.200	-8.200
30	2.900	14.100	-0.131228	254	25.300	-8.300
31	3.000	14.000	-0.131233	255	25.400	-8.400
32	3.100	13.900	-0.131237	256	25.500	-8.500
33	3.200	13.800	-0.131291	257	25.600	-8.600
34	3.300	13.700	-0.131295	258	25.700	-8.700
35	3.400	13.600	-0.131299	259	25.800	-8.800
36	3.500	13.500	-0.131302	260	25.900	-8.900
37	3.600	13.400	-0.131356	261	26.000	-9.000
38	3.700	13.300	-0.131359	262	26.100	-9.100
39	3.800	13.200	-0.131362	263	26.200	-9.200

Inches
mm

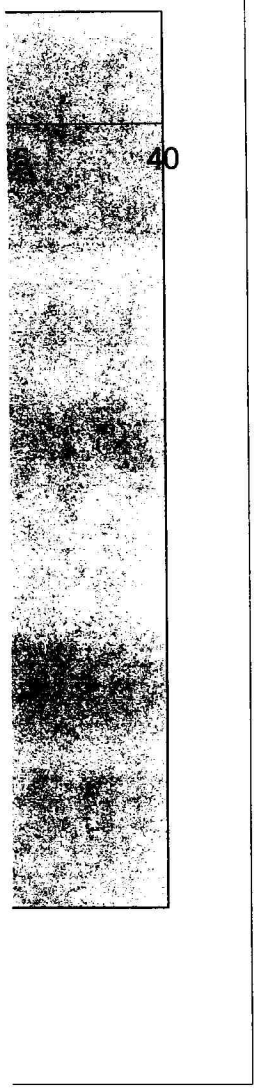
Inches
mm

nm

nm

Inches

mm



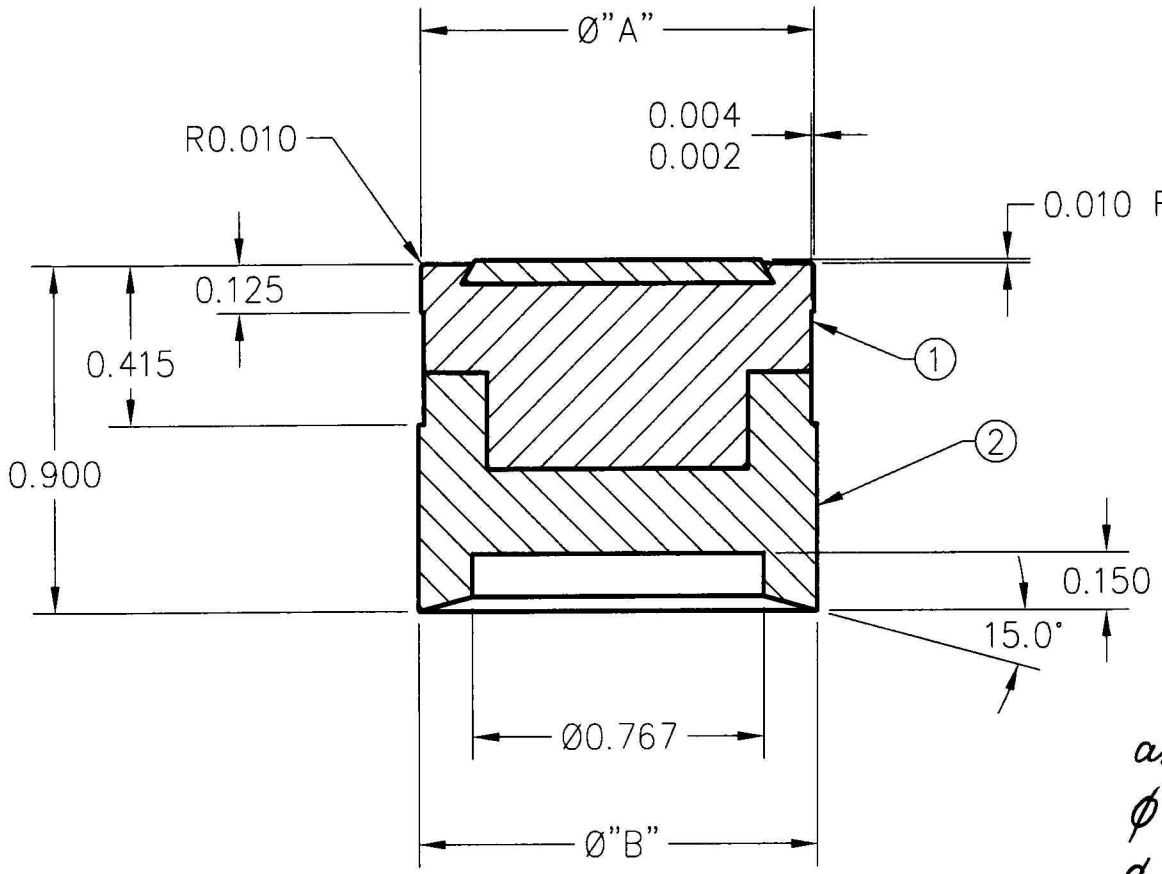
40	3.900	13.100	-0.131365	264	26.300	-9.300
41	4.000	13.000	-0.131367	265	26.400	-9.400
42	4.100	12.900	-0.131370	266	26.500	-9.500
43	4.200	12.800	-0.131422	267	26.600	-9.600
44	4.300	12.700	-0.131424	268	26.700	-9.700
45	4.400	12.600	-0.131426	269	26.800	-9.800
46	4.500	12.500	-0.131478	270	26.900	-9.900
47	4.600	12.400	-0.131430	271	27.000	-10.000
48	4.700	12.300	-0.131481	272	27.100	-10.100
49	4.800	12.200	-0.131482	273	27.200	-10.200
50	4.900	12.100	-0.131484	274	27.300	-10.300
51	5.000	12.000	-0.131535	275	27.400	-10.400
52	5.100	11.900	-0.131486	276	27.500	-10.500
53	5.200	11.800	-0.131537	277	27.600	-10.600
54	5.300	11.700	-0.131537	278	27.700	-10.700
55	5.400	11.600	-0.131538	279	27.800	-10.800
56	5.500	11.500	-0.131538	280	27.900	-10.900
57	5.600	11.400	-0.131539	281	28.000	-11.000
58	5.700	11.300	-0.131539	282	28.100	-11.100
59	5.800	11.200	-0.131589	283	28.200	-11.200
60	5.900	11.100	-0.131589	284	28.300	-11.300
61	6.000	11.000	-0.131589	285	28.400	-11.400
62	6.100	10.900	-0.131588	286	28.500	-11.500
63	6.200	10.800	-0.131588	287	28.600	-11.600
64	6.300	10.700	-0.131587	288	28.700	-11.700
65	6.400	10.600	-0.131587	289	28.800	-11.800
66	6.500	10.500	-0.131586	290	28.900	-11.900
67	6.600	10.400	-0.131585	291	29.000	-12.000
68	6.700	10.300	-0.131584	292	29.100	-12.100
69	6.800	10.200	-0.131583	293	29.200	-12.200
70	6.900	10.100	-0.131582	294	29.300	-12.300
71	7.000	10.000	-0.131581	295	29.400	-12.400
72	7.100	9.900	-0.131630	296	29.500	-12.500
73	7.200	9.800	-0.131578	297	29.600	-12.600
74	7.300	9.700	-0.131577	298	29.700	-12.700
75	7.400	9.600	-0.131575	299	29.800	-12.800
76	7.500	9.500	-0.131574	300	29.900	-12.900
77	7.600	9.400	-0.131572	301	30.000	-13.000
78	7.700	9.300	-0.131570	302	30.100	-13.100
79	7.800	9.200	-0.131568	303	30.200	-13.200
80	7.900	9.100	-0.131566	304	30.300	-13.300
81	8.000	9.000	-0.131564	305	30.400	-13.400
82	8.100	8.900	-0.131512	306	30.500	-13.500
83	8.200	8.800	-0.131510	307	30.600	-13.600
84	8.300	8.700	-0.131508	308	30.700	-13.700
85	8.400	8.600	-0.131506	309	30.800	-13.800
86	8.500	8.500	-0.131503	310	30.900	-13.900

87	8.600	8.400	-0.131451	311	31.000	-14.000
88	8.700	8.300	-0.131448	312	31.100	-14.100
89	8.800	8.200	-0.131446	313	31.200	-14.200
90	8.900	8.100	-0.131393	314	31.300	-14.300
91	9.000	8.000	-0.131391	315	31.400	-14.400
92	9.100	7.900	-0.131388	316	31.500	-14.500
93	9.200	7.800	-0.131385	317	31.600	-14.600
94	9.300	7.700	-0.131382	318	31.700	-14.700
95	9.400	7.600	-0.131330	319	31.800	-14.800
96	9.500	7.500	-0.131327	320	31.900	-14.900
97	9.600	7.400	-0.131324	321	32.000	-15.000
98	9.700	7.300	-0.131271	322	32.100	-15.100
99	9.800	7.200	-0.131268	323	32.200	-15.200
100	9.900	7.100	-0.131265	324	32.300	-15.300
101	10.000	7.000	-0.131262	325	32.400	-15.400
102	10.100	6.900	-0.131209	326	32.500	-15.500
103	10.200	6.800	-0.131206	327	32.600	-15.600
104	10.300	6.700	-0.131202	328	32.700	-15.700
105	10.400	6.600	-0.131199	329	32.800	-15.800
106	10.500	6.500	-0.131196	330	32.900	-15.900
107	10.600	6.400	-0.131193	331	33.000	-16.000
108	10.700	6.300	-0.131189	332	33.100	-16.100
109	10.800	6.200	-0.131136	333	33.200	-16.200
110	10.900	6.100	-0.131133	334	33.300	-16.300
111	11.000	6.000	-0.131029	335	33.400	-16.400
112	11.100	5.900	-0.131026	336	33.500	-16.500
113	11.200	5.800	-0.131023	337	33.600	-16.600
114	11.300	5.700	-0.131019	338	33.700	-16.700
115	11.400	5.600	-0.130916	339	33.800	-16.800
116	11.500	5.500	-0.130512	340	33.900	-16.900
117	11.600	5.400	-0.129230	341	34.000	-17.000

				1st	2nd	3 rd
	Number	Reading	abs dist.	Run	Run	Run
	of	Distance		Reading	Reading	Reading
North(right	Reading	mm	mm	Inches	Inches	Inches
-0.12484	118	11.700	5.300			
-0.12639	119	11.800	5.200			
-0.12813	120	11.900	5.100			
-0.13048	121	12.000	5.000			
-0.13088	122	12.100	4.900			
-0.13093	123	12.200	4.800			
-0.13087	124	12.300	4.700	-0.00040		
-0.13092	125	12.400	4.600	-0.00030		
-0.13092	126	12.500	4.500	-0.00075	-0.00045	
-0.13097	127	12.600	4.400	-0.00035	-0.00070	
-0.13096	128	12.700	4.300	-0.00015	-0.00085	
-0.13101	129	12.800	4.200	-0.00020	-0.00045	
-0.13101	130	12.900	4.100	-0.00015	-0.00025	-0.00075
-0.13101	131	13.000	4.000	-0.00015	-0.00030	-0.00090
-0.13105	132	13.100	3.900	-0.00020	-0.00030	-0.00075
-0.13105	133	13.200	3.800	-0.00015	-0.00030	-0.00075
-0.13105	134	13.300	3.700	-0.00015	-0.00030	-0.00040
-0.13104	135	13.400	3.600	-0.00015	-0.00030	-0.00040
-0.13109	136	13.500	3.500	-0.00015	-0.00020	-0.00040
-0.13109	137	13.600	3.400	-0.00015	-0.00020	-0.00040
-0.13109	138	13.700	3.300	-0.00010	-0.00025	-0.00040
-0.13113	139	13.800	3.200	-0.00010	-0.00020	-0.00040
-0.13113	140	13.900	3.100	-0.00010	-0.00020	-0.00040
-0.13118	141	14.000	3.000	-0.00010	-0.00020	-0.00040
-0.13117	142	14.100	2.900	-0.00010	-0.00020	-0.00040
-0.13117	143	14.200	2.800	-0.00005	-0.00020	-0.00035
-0.13117	144	14.300	2.700	-0.00005	-0.00020	-0.00035
-0.13117	145	14.400	2.600	-0.00005	-0.00015	-0.00035
-0.13121	146	14.500	2.500	0.00000	-0.00015	-0.00030
-0.13121	147	14.600	2.400	0.00000	-0.00015	-0.00030
-0.13121	148	14.700	2.300	0.00000	-0.00015	-0.00030
-0.13125	149	14.800	2.200	-0.00005	-0.00015	-0.00030
-0.13125	150	14.900	2.100	0.00000	-0.00015	-0.00030
-0.13125	151	15.000	2.000	0.00000	-0.00015	-0.00030
-0.13129	152	15.100	1.900	0.00000	-0.00015	-0.00030
-0.13129	153	15.200	1.800	0.00000	-0.00010	-0.00030
-0.13128	154	15.300	1.700	0.00000	-0.00010	-0.00025
-0.13128	155	15.400	1.600	0.00000	-0.00010	-0.00025
-0.13133	156	15.500	1.500	0.00000	-0.00010	-0.00030

-0.13132	157	15.600	1.400	0.00000	0.00000	-0.00025
-0.13132	158	15.700	1.300	0.00005	-0.00010	-0.00025
-0.13131	159	15.800	1.200	0.00000	-0.00010	-0.00025
-0.13131	160	15.900	1.100	0.00005	-0.00005	-0.00025
-0.13131	161	16.000	1.000	0.00005	-0.00005	-0.00025
-0.13130	162	16.100	0.900	0.00005	-0.00005	-0.00025
-0.13130	163	16.200	0.800	0.00005	-0.00005	-0.00020
-0.13129	164	16.300	0.700	0.00005	-0.00005	-0.00025
-0.13129	165	16.400	0.600	0.00005	-0.00005	-0.00025
-0.13128	166	16.500	0.500	0.00005	-0.00005	-0.00025
-0.13128	167	16.600	0.400	0.00005	-0.00010	-0.00025
-0.13128	168	16.700	0.300	0.00010	-0.00005	-0.00020
-0.13127	169	16.800	0.200	0.00005	-0.00005	-0.00025
-0.13127	170	16.900	0.100	0.00005	-0.00005	-0.00025
-0.13126	171	17.000	0.000	0.00005	-0.00010	-0.00025
-0.13126	172	17.100	-0.100	0.00005	-0.00005	-0.00020
-0.13125	173	17.200	-0.200	0.00005	-0.00010	-0.00025
-0.13124	174	17.300	-0.300	0.00005	-0.00010	-0.00025
-0.13124	175	17.400	-0.400	0.00005	-0.00010	-0.00020
-0.13123	176	17.500	-0.500	0.00005	-0.00010	-0.00025
-0.13123	177	17.600	-0.600	0.00000	-0.00010	-0.00025
-0.13122	178	17.700	-0.700	0.00005	-0.00010	-0.00025
-0.13122	179	17.800	-0.800	0.00005	-0.00010	-0.00025
-0.13121	180	17.900	-0.900	0.00005	-0.00005	-0.00025
-0.13120	181	18.000	-1.000	0.00005	-0.00010	-0.00025
-0.13120	182	18.100	-1.100	0.00005	-0.00010	-0.00025
-0.13114	183	18.200	-1.200	0.00005	-0.00010	-0.00030
-0.13113	184	18.300	-1.300	0.00005	-0.00010	-0.00030
-0.13113	185	18.400	-1.400	0.00005	-0.00010	-0.00030
-0.13112	186	18.500	-1.500	0.00000	-0.00010	-0.00030
-0.13111	187	18.600	-1.600	0.00000	-0.00010	-0.00030
-0.13111	188	18.700	-1.700	0.00000	-0.00010	-0.00030
-0.13110	189	18.800	-1.800	0.00000	-0.00010	-0.00030
-0.13109	190	18.900	-1.900	0.00000	-0.00015	-0.00030
-0.13104	191	19.000	-2.000	0.00000	-0.00015	-0.00030
-0.13108	192	19.100	-2.100	0.00000	-0.00015	-0.00030
-0.13102	193	19.200	-2.200	-0.00005	-0.00015	-0.00030
-0.13101	194	19.300	-2.300	0.00000	-0.00015	-0.00035
-0.13100	195	19.400	-2.400	0.00000	-0.00015	-0.00035
-0.13100	196	19.500	-2.500	-0.00005	-0.00015	-0.00035
-0.13099	197	19.600	-2.600	-0.00005	-0.00015	-0.00035
-0.13098	198	19.700	-2.700	-0.00005	-0.00015	-0.00040
-0.13097	199	19.800	-2.800	-0.00005	-0.00015	-0.00035
-0.13096	200	19.900	-2.900	-0.00005	-0.00015	-0.00040
-0.13090	201	20.000	-3.000	-0.00005	-0.00020	-0.00040
-0.13089	202	20.100	-3.100	-0.00005	-0.00015	-0.00035
-0.13088	203	20.200	-3.200	-0.00005	-0.00020	-0.00040

-0.13087	204	20.300	-3.300	-0.00010	-0.00020	-0.00035
-0.13071	205	20.400	-3.400	-0.00010	-0.00020	-0.00040
-0.13070	206	20.500	-3.500	-0.00005	-0.00020	-0.00065
-0.13074	207	20.600	-3.600	-0.00010	-0.00015	-0.00085
-0.13073	208	20.700	-3.700	-0.00010	-0.00015	-0.00095
-0.13067	209	20.800	-3.800	-0.00005	-0.00015	-0.00055
-0.13071	210	20.900	-3.900	-0.00005	-0.00025	-0.00015
-0.13065	211	21.000	-4.000	-0.00005	-0.00055	0.00145
-0.13069	212	21.100	-4.100	-0.00015	-0.00060	0.00175
-0.13063	213	21.200	-4.200	-0.00040	-0.00095	0.00170
-0.13061	214	21.300	-4.300	-0.00050	-0.00040	
-0.13055	215	21.400	-4.400	-0.00035	-0.00005	
-0.13054	216	21.500	-4.500	0.00005	0.00010	
-0.13053	217	21.600	-4.600	0.00015		
-0.13057	218	21.700	-4.700	0.00015		
-0.13050	219	21.800	-4.800			
-0.13044	220	21.900	-4.900			
-0.13048	221	22.000	-5.000			
-0.13051	222	22.100	-5.100			
-0.13050	223	22.200	-5.200			
-0.13049	224	22.300	-5.300			
-0.13047						
-0.13051						
-0.13049						
-0.13053						
-0.13051						
-0.13050						
-0.13048						
-0.13051						
-0.13060						
-0.13158						



as built
Ø.0.9799
Ø 0.9904

0.0612 Ta 10-15-10

SHOT# 4176

A	0.9800	+.0000 −.0005
B	0.9905	+.0005 −.0000

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-048	1
1	Sabot & Flyer Plate	LGG-049	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

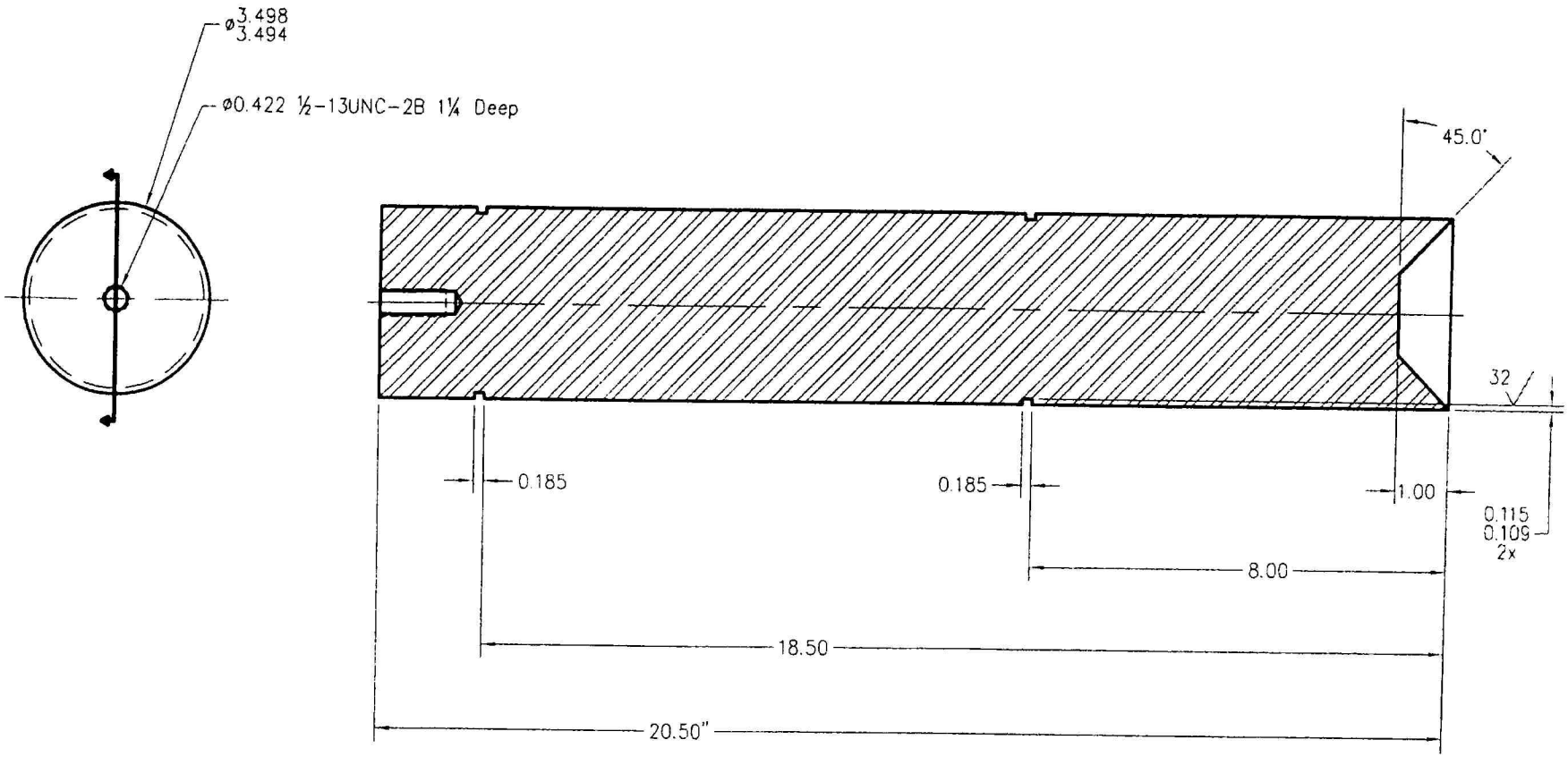
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long DATE 1/23/04
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE
Projectile Assy.

FINISH 16
MATERIAL Zelux-M&HDP
SCALE 2:1
SHEET 2 of 2
A
DRAWING NUMBER LGG-050



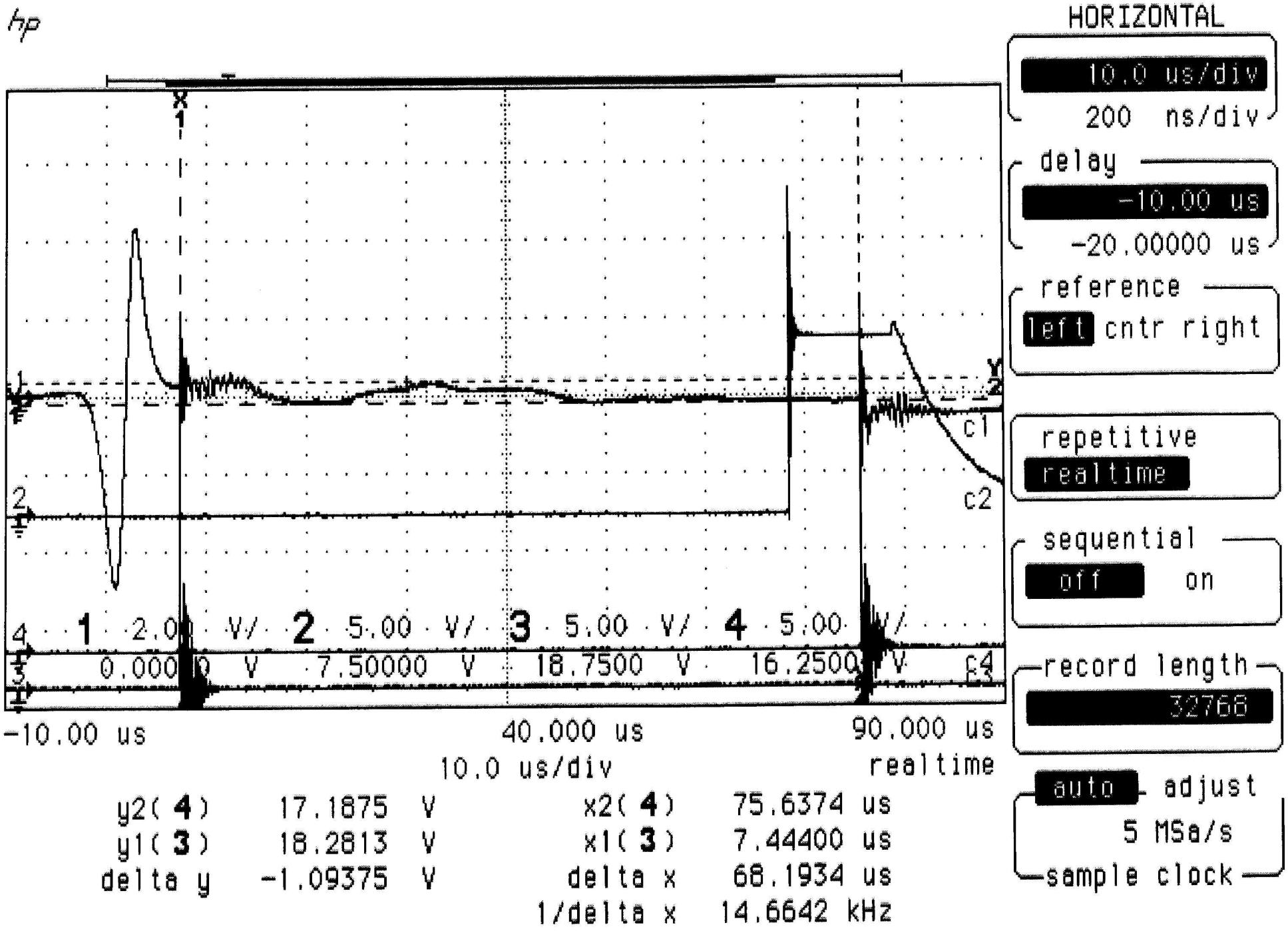
Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

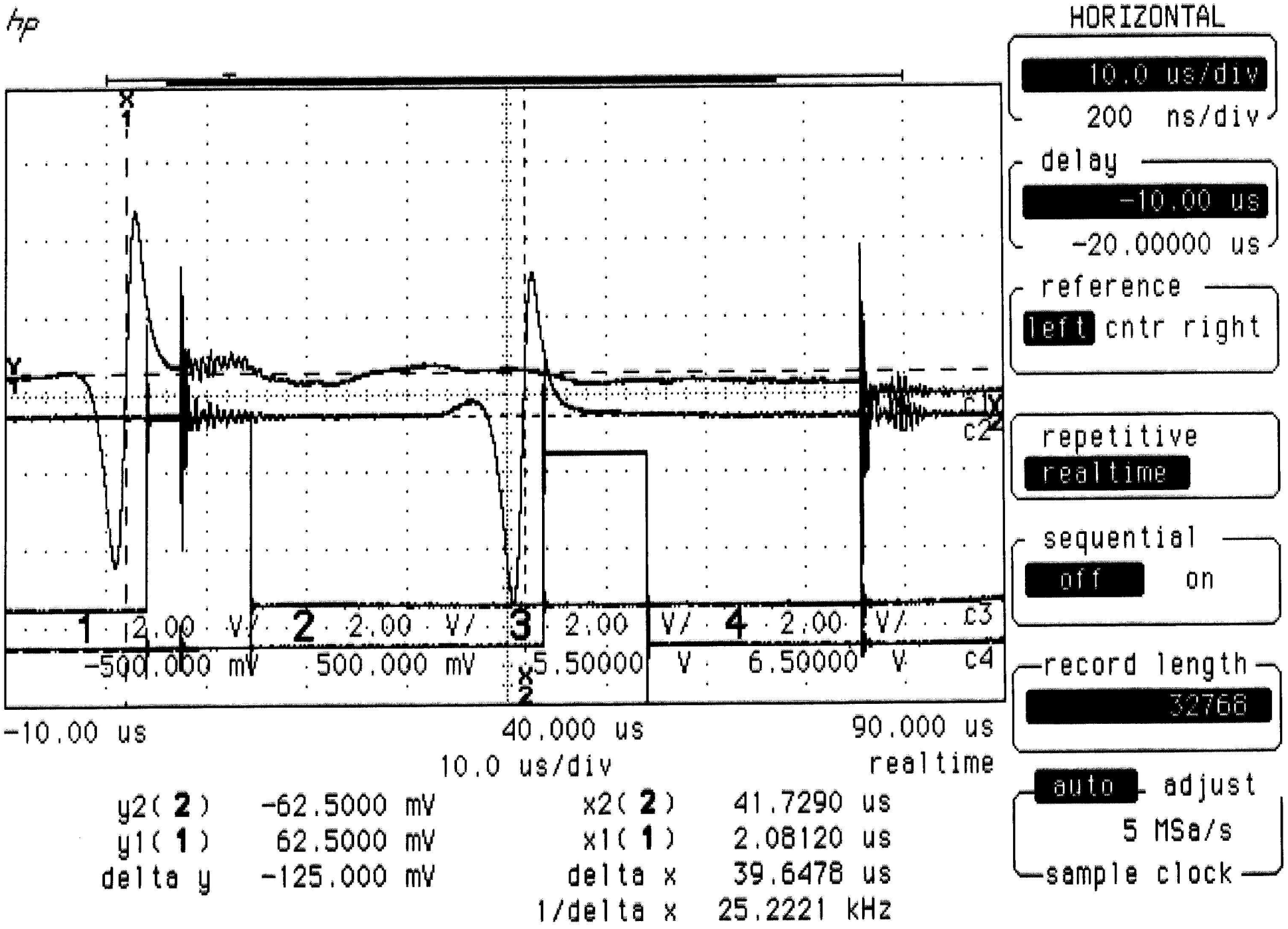
REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH 63

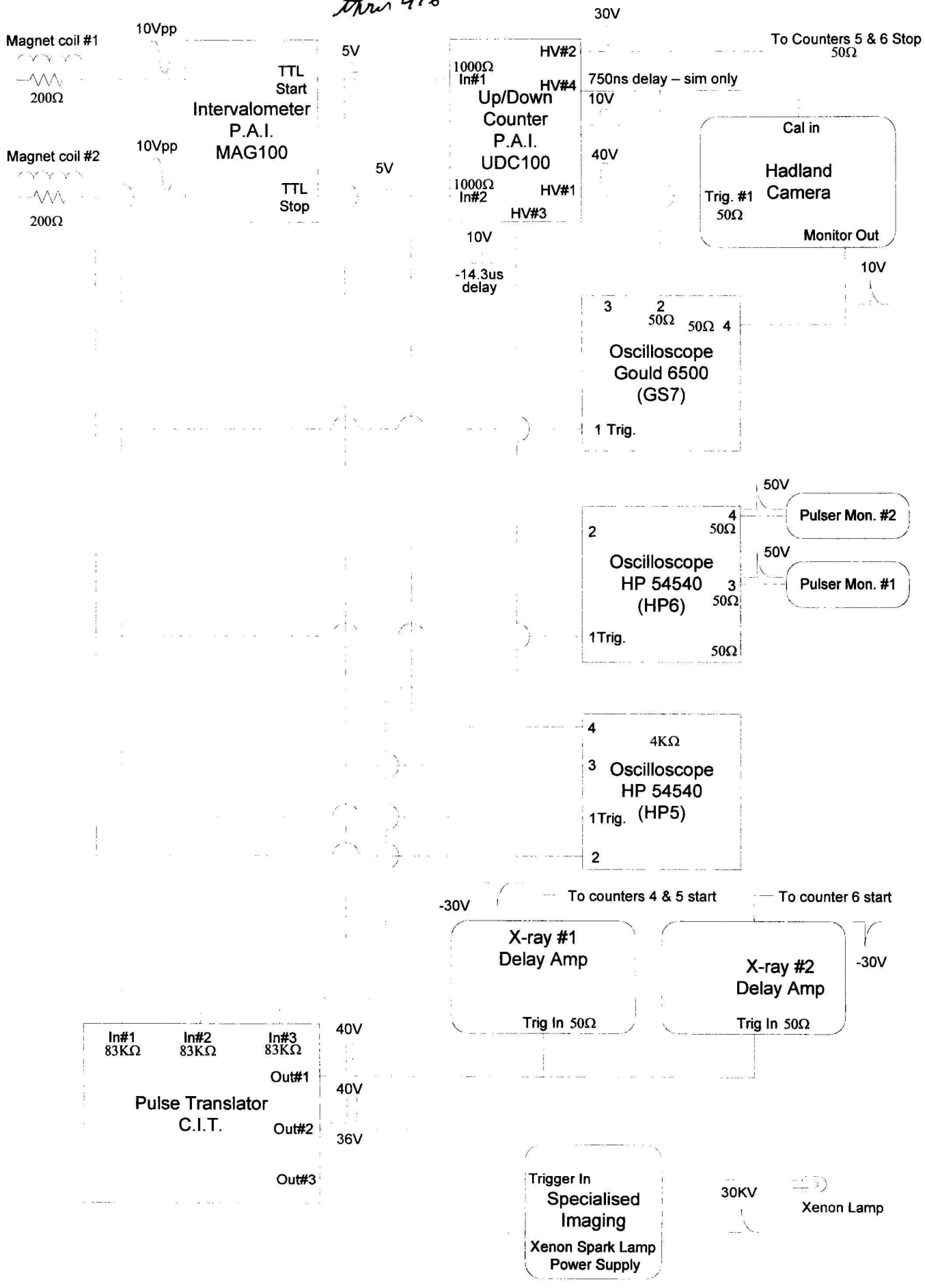
DRAWN M. Long	DATE 10/04/01	CALIFORNIA INSTITUTE of TECHNOLOGY SHOCK WAVE LABORATORY
ENGINEER	DATE	TITLE PISTON -1 Piece
APPROVED	DATE	
MATERIAL H.D. POLY	SCALE 1:2	SHEET 1 of 1
B	DRAWING NUMBER LGG-029	


hp
HORIZONTAL
10.0 us/div
200 ns/div
delay
-10.00 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32766
auto adjust
5 MSa/s
sample clock
c1
c2
1 2.00 V/ 2 5.00 V/ 3 5.00 V/ 4 5.00 V/
0.000 V 7.50000 V 18.7500 V 16.2500 V
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(4) 17.1875 V
y1(3) 18.2813 V
delta y -1.09375 V
x2(4) 75.6374 us
x1(3) 7.44400 us
delta x 68.1934 us
1/delta x 14.6642 kHz

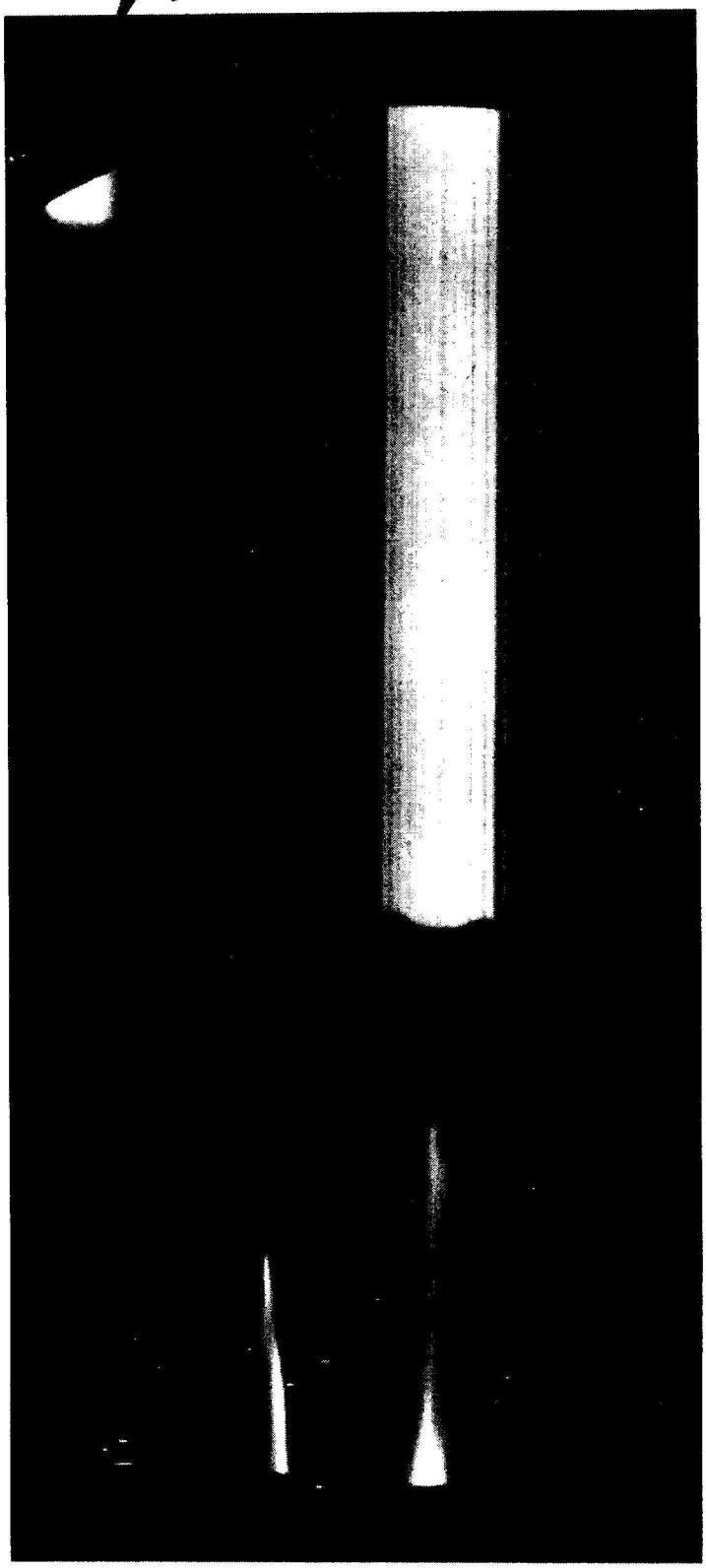

hp
HORIZONTAL
10.0 us/div
200 ns/div
delay
-10.00 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32766
auto adjust
5 MSa/s
sample clock
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/ c3
-500.000 mV 500.000 mV 5.50000 V 6.50000 V c4
-10.00 us
40.000 us
10.0 us/div
90.000 us
realtime
y2(2) -62.5000 mV
y1(1) 62.5000 mV
delta y -125.000 mV
x2(2) 41.7290 us
x1(1) 2.08120 us
delta x 39.6478 us
1/delta x 25.2221 kHz

Shot #413 Scope Schematic

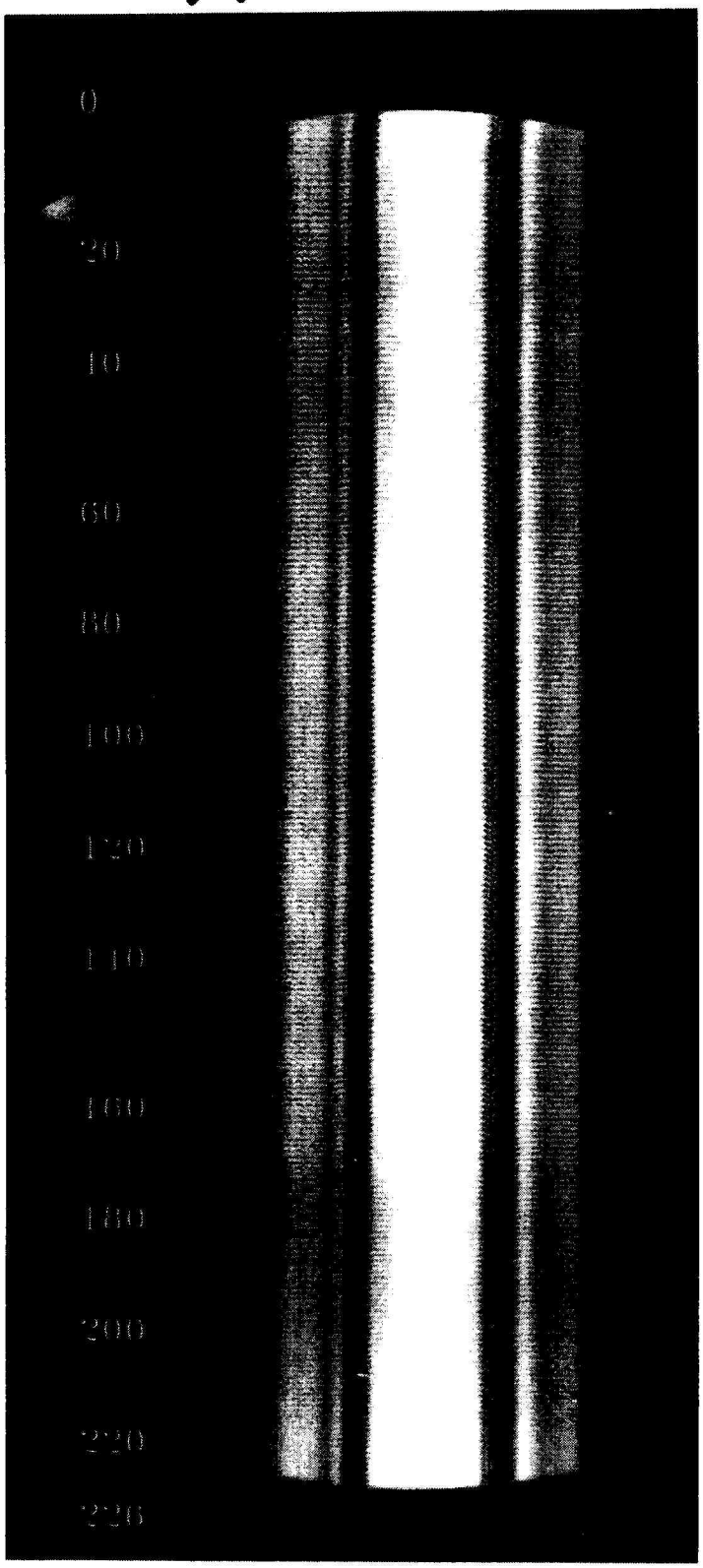
thru 416



416 Shot

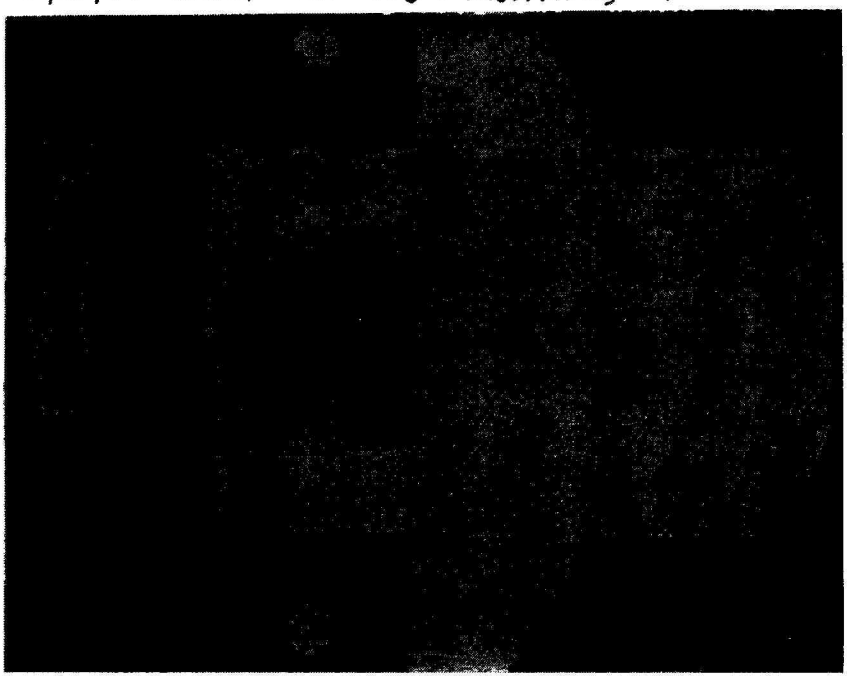


416 Cal.

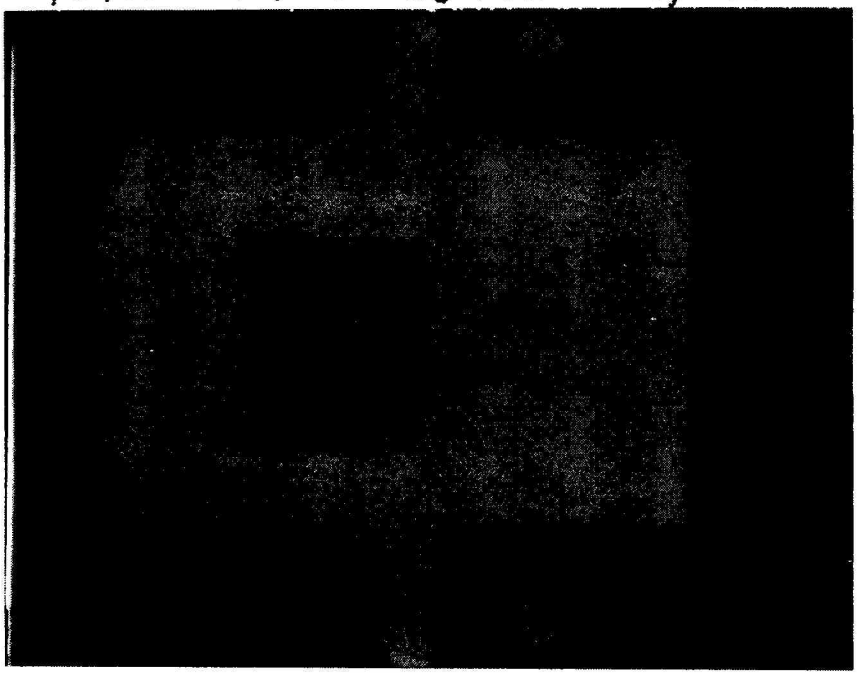


226 × 6.757ns = 1527ns

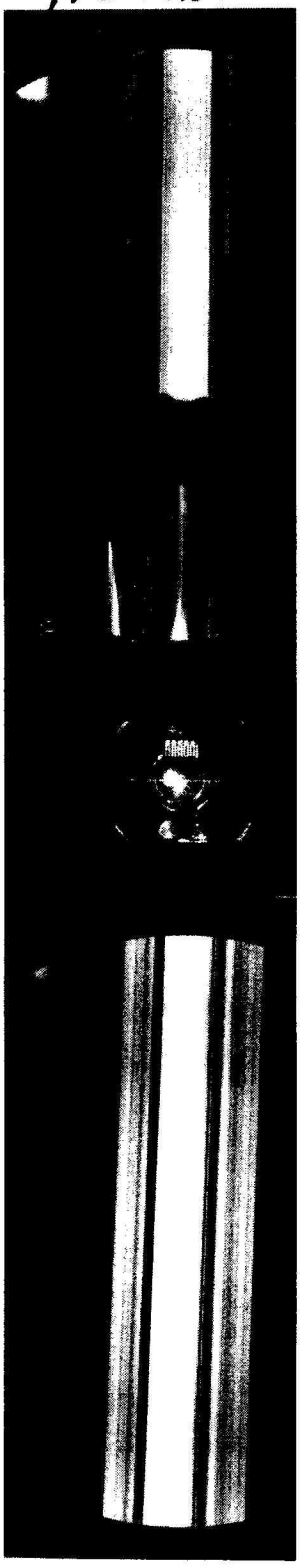
11/5/10 LGG Shot 416 Flash Xray #1



11/5/10 LGG Shot 416 Flash Xray #2



416 Shot



LIGHT GAS GUN DATA SHEET

Shot No. 417 Date 11/18/10

Target:

Sample Material Hedenbergite #9 Crystallographic orientation _____

Source Location Univ. of Michigan Thickness:1 _____ in.

Type of Measurement EOS - preheated to 1400°C 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. Driver Plate Thickness _____ in.
(shim to driver) Material _____

Projectile:

Weight 18.241 gms. Length 0.9100 in. Skirt Diameter 0.9906 in.

Flyer Plate Material Ta Leading Edge Dia. 0.9800 in.

Thickness 0.0609 in. Major Dia. 0.8130 in. Depth Inserted 2" in.

Minor Dia. 0.75 in.

Barrel Dimensions:

Breech Diameter 0.9873 in. Muzzle Diameter 0.980 in. Taper 0.007 in.

Ellipticity @ projectile depth insertion point 0.001 in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth .110 in.

Diameter: Front 3.496 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 513 gms. Type IMR4350 Total Charge 525 gms.

Primer Charge 12 gms. Type IMR4350

Expected Velocity:

Projectile 4.6 km/sec Piston 0.56 km/sec

Notes:

1404°C

4.04 KV plate 4½ minutes total heating time

L.G.G.

Camera Streak Duration: 1530 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.84

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 3.42 µsec Flash X-ray #2 80.64 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0549 in. min.	0.0930 in. min.
0.0561 in. max.	0.0936 in. max

Expected Burst Pressure 4K psi

Instrument Tank/Vacuum Pump Pressure: 68/58 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.65 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.559 km/sec

Piston Velocity from Gauge #1 to #3: 0.555 km/sec

Projectile Velocity from UDC: 4540 m/sec

Projectile Velocity from X-ray: _____ km/sec

4529

L.G.G.

COUNTER CONNECTIONS

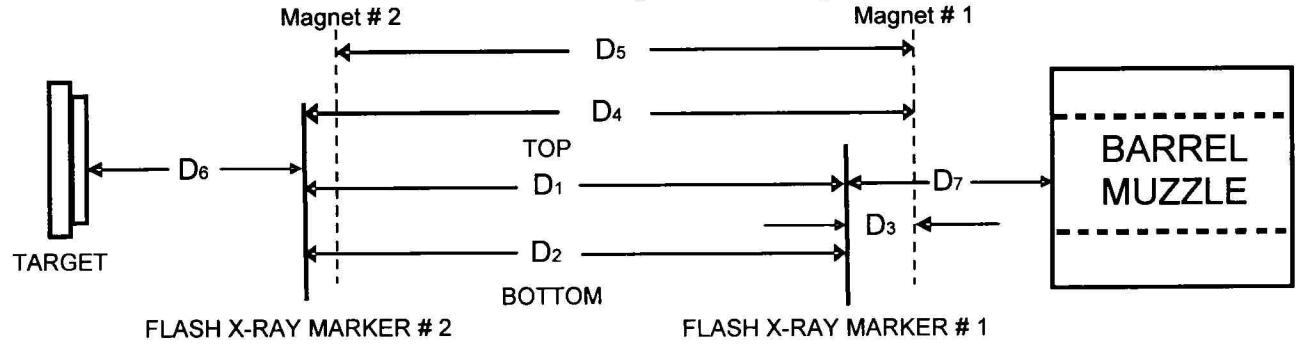
	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	545 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1099 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	44.9 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	76.858 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	85.437 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	8.583 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	76.875 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	44.85 µsec
UDC Velocity:			4539.69 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 $\times_1$ 2.2970	Velocity magnet 2 $\times_2$ 47.1574	44.860 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start $\times_3$ 4.3288	2.032 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop $\times_4$ 49.1770	2.020 µsec
HP6, 1-2:	Velocity Magnet 1 $\times_1$ 2.3138	Xenon Lamp Trigger $\times_2$ 79.1028	76.789 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out $\times_3$ 8.3424	X-ray 2 Pulser Monitor Out $\times_4$ 85.2156	76.873 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	91.117 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	91.402 µsec

TARGET MEASUREMENT

Shot No. **417** Expected Velocity: **4.60** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	37.0	99.0
Measure # 2, mm	30.00	383.15	203.66	36.0	99.0
Average, mm	30.00	383.15	203.61	36.5	99.0
Travel time, µsec	**6.52**	**83.29**	**44.26**	**7.93**	**21.52**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **76.79** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **76.76** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **3.42** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **80.64** µsec.

MAGNET DISTANCE

Shot No. **417** Expected Velocity: **4.60**

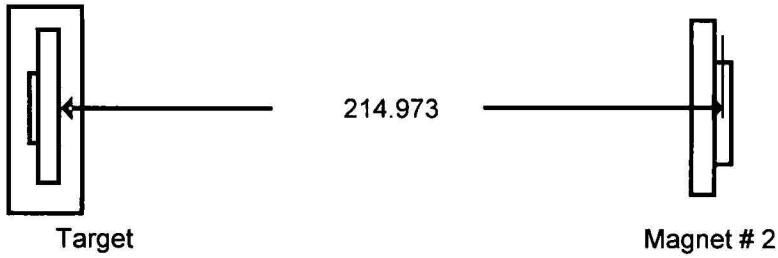
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **44.262 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.338 inch

Second measurement = 8.339 inch

Average measurement = 8.339 inch

Average measurement = 211.798 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 214.973 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **46.733 µsec.**

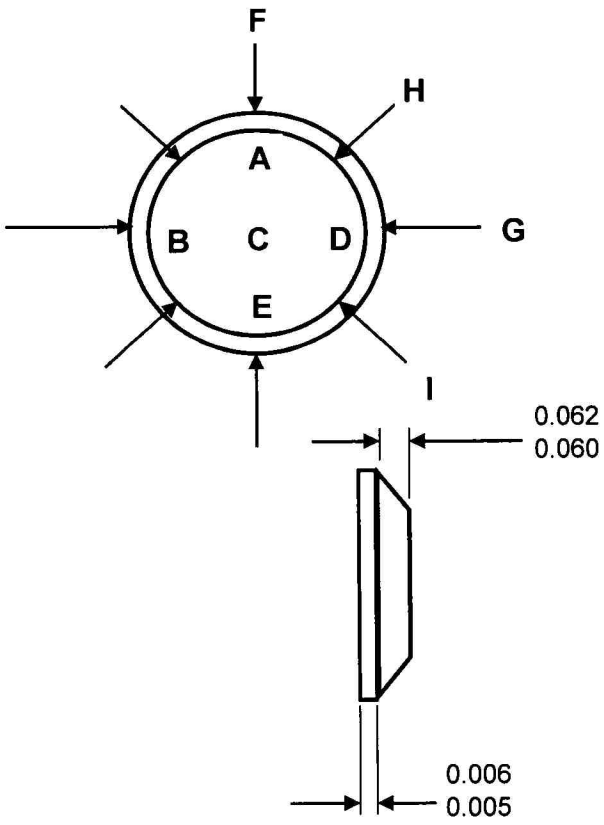
Fudged Distance between Magnet 2 to Target = ~~.0 mm~~ 0.200291

SHOT No.

FLYER PLATE MATERIAL: **Ta # 27** 8/18/2010

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06070	F	0.81300
A	0.06090	F	0.81300
B	0.06070	G	0.81300
B	0.06085	G	0.81300
C	0.06100	H	0.75000
C	0.06095	H	0.75000
D	0.06100	I	0.75000
D	0.06105	I	0.75000
E	0.06095		
E	0.06100		



Statistic for thickness

N	10	
MAX	0.06105	
MIN	0.06070	
Range	0.00035	
MEAN	0.060921429	inch
	1.547404286	mm
STDEV	0.000118523	

Statistic for Diameter (F-G)

N	4	
MAX	0.81300	
MIN	0.81300	
Range	0.00000	
MEAN	0.8130000	inch
	20.6502000	mm
STDEV	0	

Statistic for Diameter (H-I)

N	4	
MAX	0.75000	
MIN	0.75000	
Range	0.00000	
MEAN	0.75	inch
	19.05	mm
STDEV	0	

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	20.9	1.88277	8.00536	9.47098	0.8648	16.5962
2	20.9	1.88272	8.00534	9.47100	0.8648	16.5997
3	20.9	1.88275	8.00535	9.47101	0.8648	16.5986
	THICKNESS		0.060921429	±		in
	FLATNESS:		0.00035	in.		
	VOLUME:		0.5183	3.01E-04		cm^3
	CRYSTAL DENSITY:		16.5982	1.80E-03		$grams/cm^3$
	BULK DENSITY:		15.4468	3.01E-04		$grams/cm^3$

DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED BY: _____ on _____

SHOT No. ____ _____ tip used: .7mm long/ flat tip

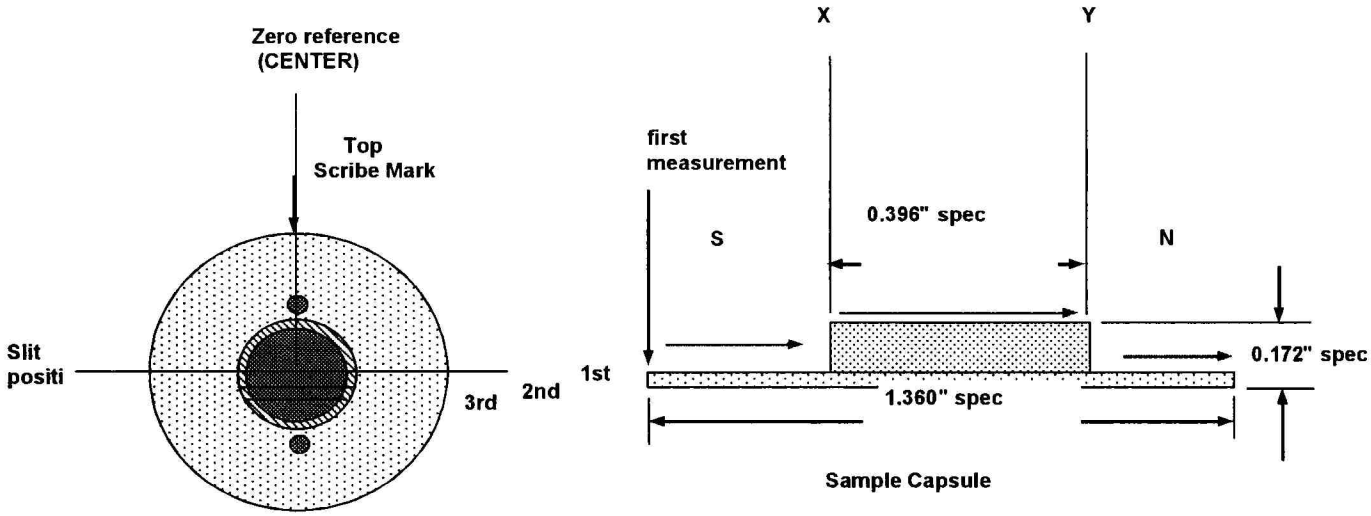
SAMPLE CAPSULE: _____9_____ note: the platform on which the measurement was taken

SAMPLE MATERIAL: Hd deviates from flat by +0.013 max.

direction of measurement

4.997

THICKNESS PROFILE (Not re-polished, but final surface) 4.661



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00015

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = -0.00033

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

Average thickness reading = -0.00053

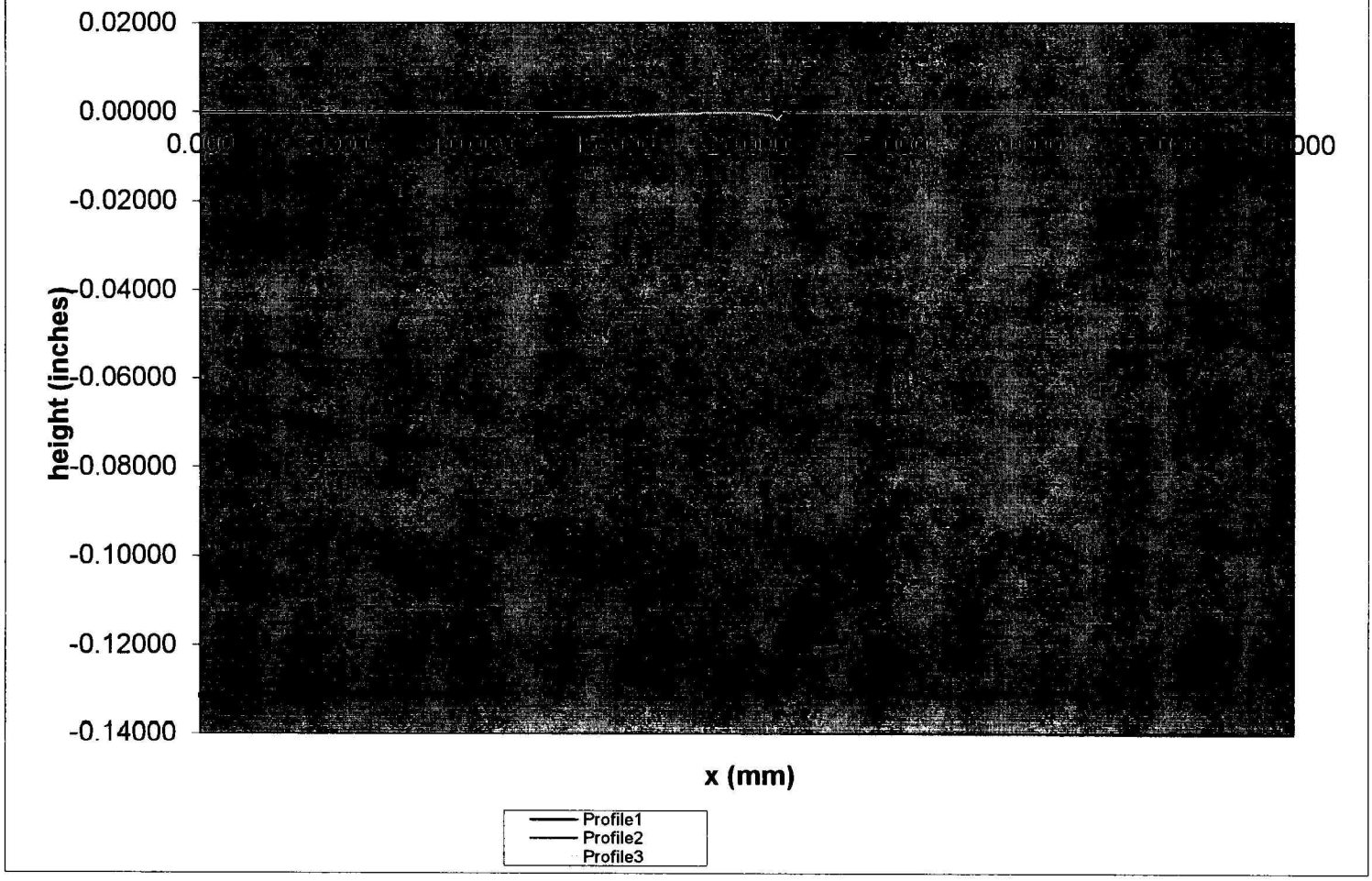
Note: Measurement from reference zero point from the base is = 0.1720 Inches
4.3688 mm

Average thickness of the driver Plate = 0.0408 Inches
1.0351 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the Carbon Deposited on the Projectile side is = nm

Distance from the top of the cap to the measured (avg) driver plate **0.13** Inches
3.33 mm


Shot # 417 Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
height (inches)
x (mm)
Profile1
Profile2
Profile3

1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

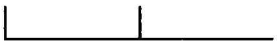
Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading
1	0.000	17.000	-0.13150	225	22.400	-5.400	-0.12594	118
2	0.100	16.900	-0.13136	226	22.500	-5.500	-0.12779	119
3	0.200	16.800	-0.13122	227	22.600	-5.600	-0.13058	120
4	0.300	16.700	-0.13113	228	22.700	-5.700	-0.13123	121
5	0.400	16.600	-0.13104	229	22.800	-5.800	-0.13128	122
6	0.500	16.500	-0.13095	230	22.900	-5.900	-0.13133	123
7	0.600	16.400	-0.13091	231	23.000	-6.000	-0.13132	124
8	0.700	16.300	-0.13092	232	23.100	-6.100	-0.13137	125
9	0.800	16.200	-0.13088	233	23.200	-6.200	-0.13132	126
10	0.900	16.100	-0.13084	234	23.300	-6.300	-0.13137	127
11	1.000	16.000	-0.13085	235	23.400	-6.400	-0.13141	128
12	1.100	15.900	-0.13086	236	23.500	-6.500	-0.13141	129
13	1.200	15.800	-0.13087	237	23.600	-6.600	-0.13141	130
14	1.300	15.700	-0.13088	238	23.700	-6.700	-0.13141	131
15	1.400	15.600	-0.13084	239	23.800	-6.800	-0.13140	132
16	1.500	15.500	-0.13084	240	23.900	-6.900	-0.13135	133
17	1.600	15.400	-0.13085	241	24.000	-7.000	-0.13135	134
18	1.700	15.300	-0.13086	242	24.100	-7.100	-0.13134	135
19	1.800	15.200	-0.13087	243	24.200	-7.200	-0.13134	136
20	1.900	15.100	-0.13092	244	24.300	-7.300	-0.13139	137
21	2.000	15.000	-0.13093	245	24.400	-7.400	-0.13139	138
22	2.100	14.900	-0.13094	246	24.500	-7.500	-0.13133	139
23	2.200	14.800	-0.13094	247	24.600	-7.600	-0.13138	140
24	2.300	14.700	-0.13095	248	24.700	-7.700	-0.13138	141
25	2.400	14.600	-0.13100	249	24.800	-7.800	-0.13137	142
26	2.500	14.500	-0.13101	250	24.900	-7.900	-0.13137	143
27	2.600	14.400	-0.13101	251	25.000	-8.000	-0.13137	144
28	2.700	14.300	-0.13107	252	25.100	-8.100	-0.13137	145
29	2.800	14.200	-0.13102	253	25.200	-8.200	-0.13141	146
30	2.900	14.100	-0.13103	254	25.300	-8.300	-0.13141	147
31	3.000	14.000	-0.13103	255	25.400	-8.400	-0.13141	148
32	3.100	13.900	-0.13109	256	25.500	-8.500	-0.13140	149
33	3.200	13.800	-0.13109	257	25.600	-8.600	-0.13145	150
34	3.300	13.700	-0.13105	258	25.700	-8.700	-0.13145	151
35	3.400	13.600	-0.13105	259	25.800	-8.800	-0.13149	152
36	3.500	13.500	-0.13110	260	25.900	-8.900	-0.13149	153
37	3.600	13.400	-0.13111	261	26.000	-9.000	-0.13148	154
38	3.700	13.300	-0.13111	262	26.100	-9.100	-0.13153	155
39	3.800	13.200	-0.13111	263	26.200	-9.200	-0.13153	156
40	3.900	13.100	-0.13116	264	26.300	-9.300	-0.13152	157
41	4.000	13.000	-0.13117	265	26.400	-9.400	-0.13152	158
42	4.100	12.900	-0.13122	266	26.500	-9.500	-0.13156	159
43	4.200	12.800	-0.13117	267	26.600	-9.600	-0.13156	160
44	4.300	12.700	-0.13117	268	26.700	-9.700	-0.13156	161
45	4.400	12.600	-0.13123	269	26.800	-9.800	-0.13155	162
46	4.500	12.500	-0.13118	270	26.900	-9.900	-0.13155	163
47	4.600	12.400	-0.13123	271	27.000	-10.000	-0.13154	164
48	4.700	12.300	-0.13123	272	27.100	-10.100	-0.13154	165
49	4.800	12.200	-0.13123	273	27.200	-10.200	-0.13158	166
50	4.900	12.100	-0.13123	274	27.300	-10.300	-0.13158	167
51	5.000	12.000	-0.13123	275	27.400	-10.400	-0.13158	168

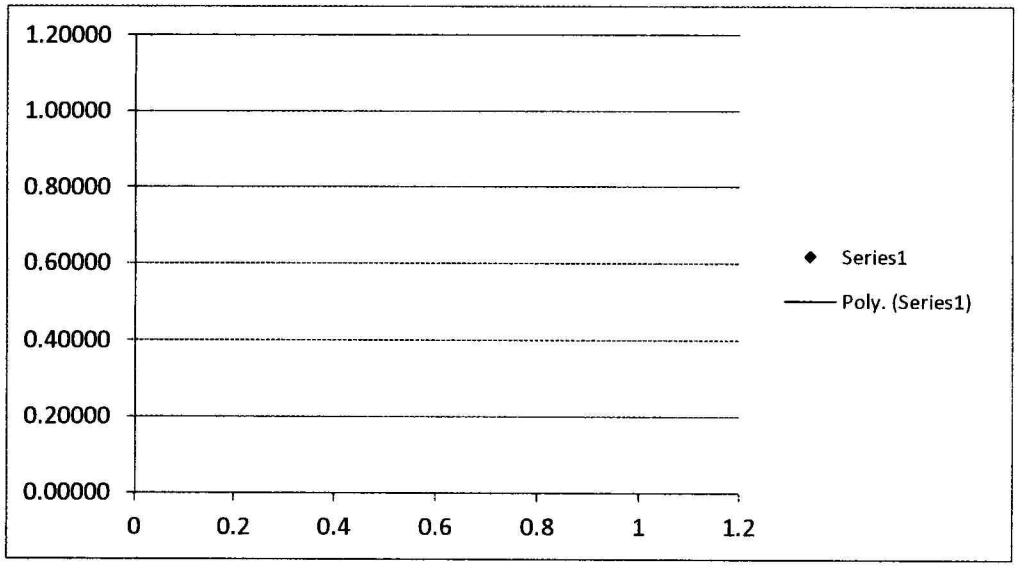
52	5.100	11.900	-0.13124	276	27.500	-10.500	-0.13157	169
53	5.200	11.800	-0.13124	277	27.600	-10.600	-0.13157	170
54	5.300	11.700	-0.13124	278	27.700	-10.700	-0.13156	171
55	5.400	11.600	-0.13129	279	27.800	-10.800	-0.13161	172
56	5.500	11.500	-0.13129	280	27.900	-10.900	-0.13160	173
57	5.600	11.400	-0.13129	281	28.000	-11.000	-0.13159	174
58	5.700	11.300	-0.13129	282	28.100	-11.100	-0.13159	175
59	5.800	11.200	-0.13134	283	28.200	-11.200	-0.13158	176
60	5.900	11.100	-0.13134	284	28.300	-11.300	-0.13158	177
61	6.000	11.000	-0.13129	285	28.400	-11.400	-0.13157	178
62	6.100	10.900	-0.13129	286	28.500	-11.500	-0.13157	179
63	6.200	10.800	-0.13129	287	28.600	-11.600	-0.13156	180
64	6.300	10.700	-0.13134	288	28.700	-11.700	-0.13155	181
65	6.400	10.600	-0.13134	289	28.800	-11.800	-0.13155	182
66	6.500	10.500	-0.13134	290	28.900	-11.900	-0.13154	183
67	6.600	10.400	-0.13129	291	29.000	-12.000	-0.13153	184
68	6.700	10.300	-0.13133	292	29.100	-12.100	-0.13153	185
69	6.800	10.200	-0.13128	293	29.200	-12.200	-0.13157	186
70	6.900	10.100	-0.13128	294	29.300	-12.300	-0.13151	187
71	7.000	10.000	-0.13128	295	29.400	-12.400	-0.13151	188
72	7.100	9.900	-0.13128	296	29.500	-12.500	-0.13150	189
73	7.200	9.800	-0.13128	297	29.600	-12.600	-0.13149	190
74	7.300	9.700	-0.13128	298	29.700	-12.700	-0.13149	191
75	7.400	9.600	-0.13128	299	29.800	-12.800	-0.13148	192
76	7.500	9.500	-0.13122	300	29.900	-12.900	-0.13147	193
77	7.600	9.400	-0.13122	301	30.000	-13.000	-0.13146	194
78	7.700	9.300	-0.13127	302	30.100	-13.100	-0.13145	195
79	7.800	9.200	-0.13127	303	30.200	-13.200	-0.13145	196
80	7.900	9.100	-0.13127	304	30.300	-13.300	-0.13144	197
81	8.000	9.000	-0.13126	305	30.400	-13.400	-0.13143	198
82	8.100	8.900	-0.13121	306	30.500	-13.500	-0.13142	199
83	8.200	8.800	-0.13121	307	30.600	-13.600	-0.13141	200
84	8.300	8.700	-0.13121	308	30.700	-13.700	-0.13140	201
85	8.400	8.600	-0.13126	309	30.800	-13.800	-0.13139	202
86	8.500	8.500	-0.13125	310	30.900	-13.900	-0.13138	203
87	8.600	8.400	-0.13130	311	31.000	-14.000	-0.13137	204
88	8.700	8.300	-0.13125	312	31.100	-14.100	-0.13136	205
89	8.800	8.200	-0.13125	313	31.200	-14.200	-0.13135	206
90	8.900	8.100	-0.13124	314	31.300	-14.300	-0.13134	207
91	9.000	8.000	-0.13119	315	31.400	-14.400	-0.13138	208
92	9.100	7.900	-0.13119	316	31.500	-14.500	-0.13142	209
93	9.200	7.800	-0.13124	317	31.600	-14.600	-0.13136	210
94	9.300	7.700	-0.13118	318	31.700	-14.700	-0.13135	211
95	9.400	7.600	-0.13118	319	31.800	-14.800	-0.13134	212
96	9.500	7.500	-0.13118	320	31.900	-14.900	-0.13133	213
97	9.600	7.400	-0.13117	321	32.000	-15.000	-0.13131	214
98	9.700	7.300	-0.13117	322	32.100	-15.100	-0.13130	215
99	9.800	7.200	-0.13117	323	32.200	-15.200	-0.13129	216
100	9.900	7.100	-0.13116	324	32.300	-15.300	-0.13128	217
101	10.000	7.000	-0.13116	325	32.400	-15.400	-0.13127	218
102	10.100	6.900	-0.13116	326	32.500	-15.500	-0.13125	219
103	10.200	6.800	-0.13116	327	32.600	-15.600	-0.13124	220
104	10.300	6.700	-0.13115	328	32.700	-15.700	-0.13128	221
105	10.400	6.600	-0.13115	329	32.800	-15.800	-0.13126	222
106	10.500	6.500	-0.13120	330	32.900	-15.900	-0.13130	223
107	10.600	6.400	-0.13114	331	33.000	-16.000	-0.13129	224
108	10.700	6.300	-0.13109	332	33.100	-16.100	-0.13132	
109	10.800	6.200	-0.13114	333	33.200	-16.200	-0.13136	
110	10.900	6.100	-0.13113	334	33.300	-16.300	-0.13139	

111	11.000	6.000	-0.13108	335	33.400	-16.400	-0.13143
112	11.100	5.900	-0.13108	336	33.500	-16.500	-0.13151
113	11.200	5.800	-0.13097	337	33.600	-16.600	-0.13155
114	11.300	5.700	-0.13097	338	33.700	-16.700	-0.13163
115	11.400	5.600	-0.13092	339	33.800	-16.800	-0.13176
116	11.500	5.500	-0.13061	340	33.900	-16.900	-0.13185
117	11.600	5.400	-0.13061	341	34.000	-17.000	-0.13185

Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
11.700	5.300			
11.800	5.200			
11.900	5.100			
12.000	5.000			
12.100	4.900			
12.200	4.800			
12.300	4.700	-0.00073		
12.400	4.600	-0.00068		
12.500	4.500	-0.00058	-0.00103	
12.600	4.400	-0.00047	-0.00082	
12.700	4.300	-0.00042	-0.00077	
12.800	4.200	-0.00042	-0.00077	
12.900	4.100	-0.00036	-0.00066	-0.00111
13.000	4.000	-0.00036	-0.00066	-0.00111
13.100	3.900	-0.00036	-0.00066	-0.00106
13.200	3.800	-0.00040	-0.00070	-0.00110
13.300	3.700	-0.00045	-0.00075	-0.00110
13.400	3.600	-0.00040	-0.00070	-0.00105
13.500	3.500	-0.00044	-0.00079	-0.00114
13.600	3.400	-0.00039	-0.00074	-0.00109
13.700	3.300	-0.00039	-0.00074	-0.00114
13.800	3.200	-0.00033	-0.00068	-0.00108
13.900	3.100	-0.00033	-0.00063	-0.00103
14.000	3.000	-0.00037	-0.00067	-0.00107
14.100	2.900	-0.00032	-0.00062	-0.00102
14.200	2.800	-0.00032	-0.00062	-0.00097
14.300	2.700	-0.00031	-0.00061	-0.00096
14.400	2.600	-0.00031	-0.00061	-0.00096
14.500	2.500	-0.00031	-0.00056	-0.00091
14.600	2.400	-0.00025	-0.00055	-0.00090
14.700	2.300	-0.00025	-0.00050	-0.00085
14.800	2.200	-0.00025	-0.00050	-0.00085
14.900	2.100	-0.00024	-0.00049	-0.00079
15.000	2.000	-0.00019	-0.00044	-0.00079
15.100	1.900	-0.00019	-0.00044	-0.00074
15.200	1.800	-0.00023	-0.00043	-0.00073
15.300	1.700	-0.00018	-0.00038	-0.00068
15.400	1.600	-0.00018	-0.00038	-0.00068
15.500	1.500	-0.00017	-0.00037	-0.00067
15.600	1.400	-0.00017	-0.00037	-0.00067
15.700	1.300	-0.00017	-0.00037	-0.00067
15.800	1.200	-0.00016	-0.00036	-0.00061
15.900	1.100	-0.00011	-0.00031	-0.00056
16.000	1.000	-0.00011	-0.00031	-0.00061
16.100	0.900	-0.00010	-0.00025	-0.00050
16.200	0.800	-0.00010	-0.00025	-0.00050
16.300	0.700	-0.00010	-0.00025	-0.00050
16.400	0.600	-0.00010	-0.00025	-0.00050
16.500	0.500	-0.00009	-0.00024	-0.00049
16.600	0.400	-0.00009	-0.00024	-0.00049
16.700	0.300	-0.00009	-0.00024	-0.00044

16.800	0.200	-0.00003	-0.00018	-0.00038
16.900	0.100	-0.00003	-0.00013	-0.00033
17.000	0.000	-0.00003	-0.00013	-0.00033
17.100	-0.100	-0.00002	-0.00012	-0.00032
17.200	-0.200	-0.00002	-0.00012	-0.00032
17.300	-0.300	-0.00002	-0.00012	-0.00032
17.400	-0.400	-0.00002	-0.00012	-0.00032
17.500	-0.500	-0.00001	-0.00011	-0.00026
17.600	-0.600	-0.00001	-0.00011	-0.00026
17.700	-0.700	0.00004	-0.00006	-0.00026
17.800	-0.800	0.00005	-0.00005	-0.00020
17.900	-0.900	0.00005	0.00000	-0.00015
18.000	-1.000	0.00005	0.00000	-0.00015
18.100	-1.100	0.00005	0.00000	-0.00015
18.200	-1.200	0.00006	0.00001	-0.00014
18.300	-1.300	0.00006	0.00001	-0.00014
18.400	-1.400	0.00006	0.00001	-0.00014
18.500	-1.500	0.00007	-0.00003	-0.00018
18.600	-1.600	0.00007	0.00002	-0.00013
18.700	-1.700	0.00007	0.00002	-0.00013
18.800	-1.800	0.00012	0.00007	-0.00008
18.900	-1.900	0.00008	0.00003	-0.00012
19.000	-2.000	0.00008	0.00003	-0.00007
19.100	-2.100	0.00008	0.00003	-0.00012
19.200	-2.200	0.00008	0.00003	-0.00012
19.300	-2.300	0.00009	0.00004	-0.00011
19.400	-2.400	0.00009	0.00004	-0.00011
19.500	-2.500	0.00009	0.00004	-0.00011
19.600	-2.600	0.00009	0.00004	-0.00006
19.700	-2.700	0.00010	0.00005	-0.00010
19.800	-2.800	0.00010	0.00005	-0.00010
19.900	-2.900	0.00010	0.00005	-0.00010
20.000	-3.000	0.00010	0.00005	-0.00010
20.100	-3.100	0.00011	0.00006	-0.00014
20.200	-3.200	0.00011	0.00001	-0.00019
20.300	-3.300	0.00011	0.00001	-0.00019
20.400	-3.400	0.00006	-0.00004	-0.00029
20.500	-3.500	0.00007	-0.00003	-0.00028
20.600	-3.600	0.00002	-0.00013	-0.00043
20.700	-3.700	0.00002	-0.00013	-0.00048
20.800	-3.800	0.00002	-0.00018	-0.00068
20.900	-3.900	-0.00002	-0.00027	-0.00087
21.000	-4.000	-0.00007	-0.00037	-0.00132
21.100	-4.100	-0.00012	-0.00057	-0.00172
21.200	-4.200	-0.00022	-0.00077	-0.00077
21.300	-4.300	-0.00036	-0.00126	
21.400	-4.400	-0.00071	-0.00176	
21.500	-4.500	-0.00086	-0.00086	
21.600	-4.600	-0.00091		
21.700	-4.700	0.00014		
21.800	-4.800			
21.900	-4.900			
22.000	-5.000			
22.100	-5.100			
22.200	-5.200			
22.300	-5.300			0.00000

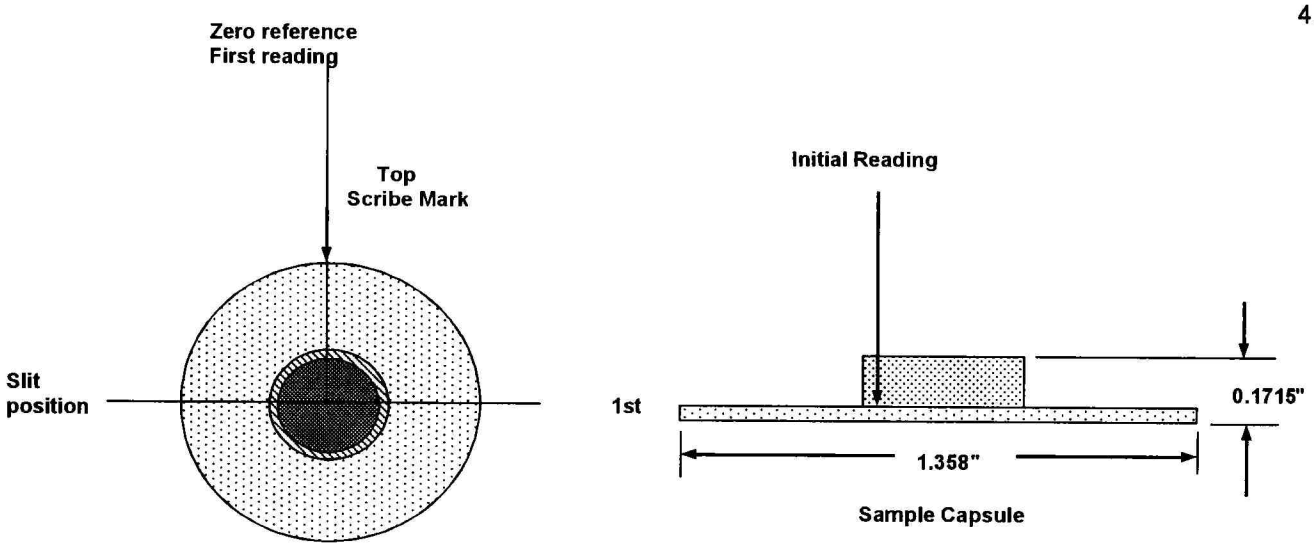



1.20000
1.00000
0.80000
0.60000
0.40000
0.20000
0.00000
0
0.2
0.4
0.6
0.8
1
1.2
Series1
Poly. (Series1)

SAMPLE CAPSULE **9** 6/7/2010
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER # 3

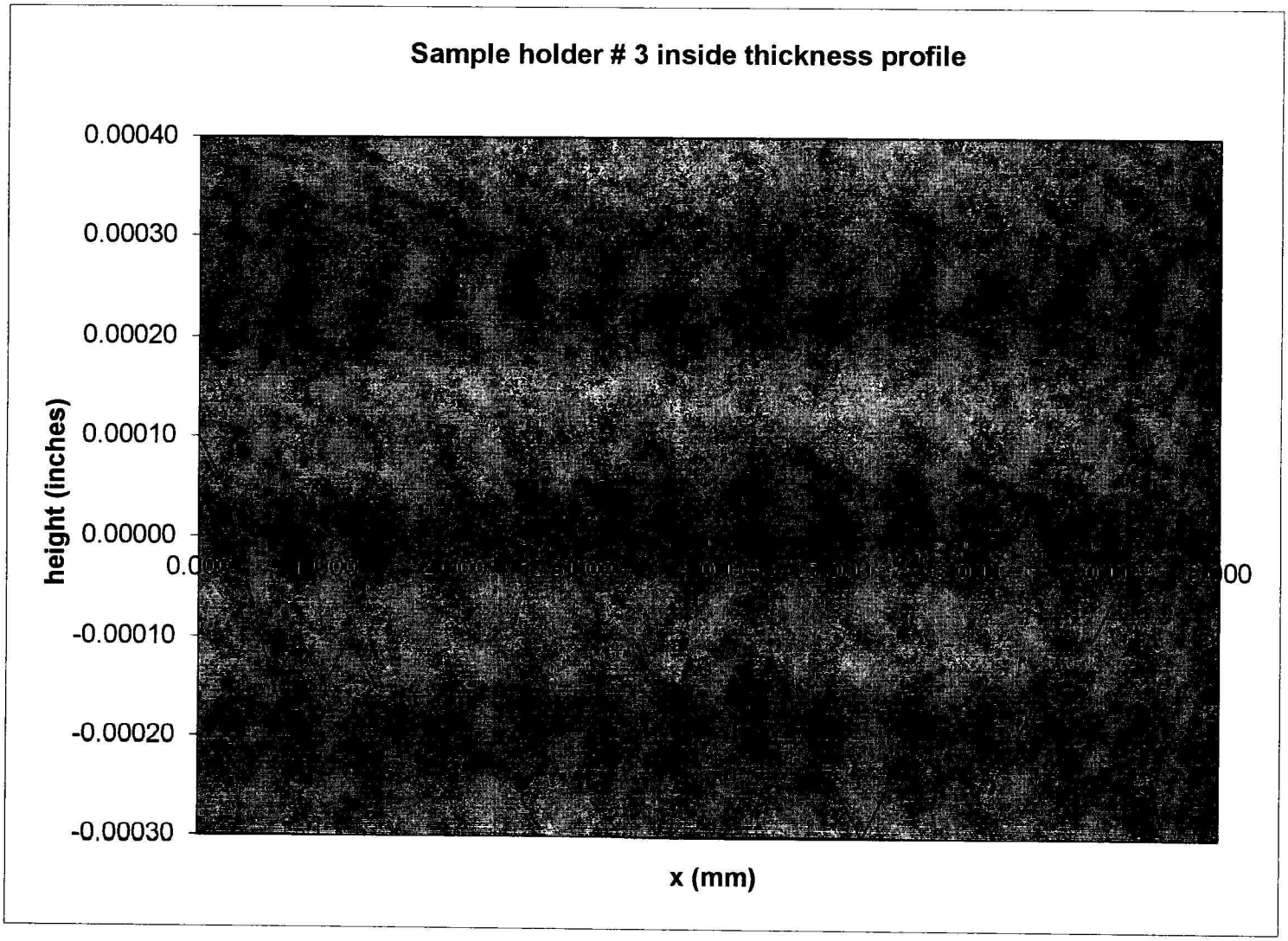
4.792
4.714



1.338582677

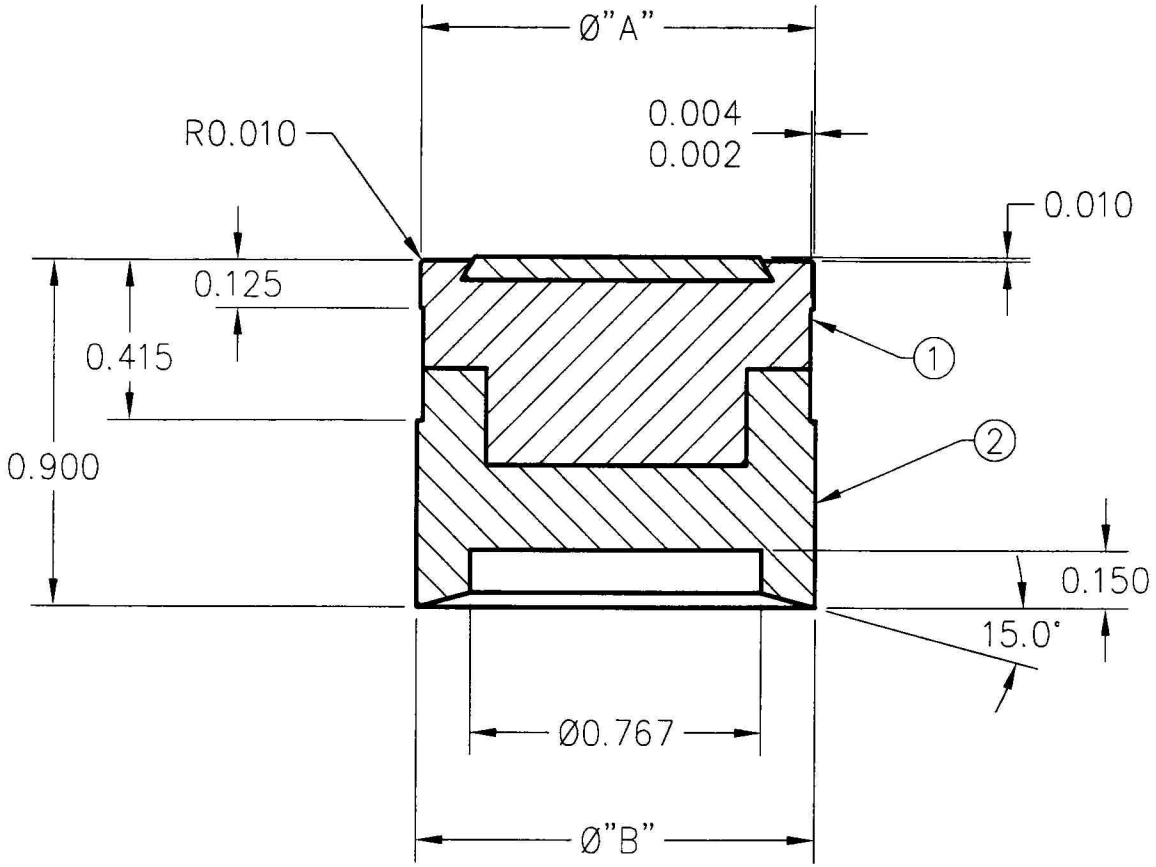
Average thickness reading = 0.00000

Note: The thickness of the reference zero point from the base is = 0.04245 Inches
1.07823 mm


Sample holder # 3 inside thickness profile
0.00040
0.00030
0.00020
0.00010
0.00000
-0.00010
-0.00020
-0.00030
height (inches)
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00010	3.544	south
2	0.200	0.00005	3.34400	
3	0.400	-0.00005	3.14400	
4	0.600	-0.00015	2.94400	
5	0.800	-0.00010	2.74400	
6	1.000	-0.00015	2.54400	
7	1.200	-0.00010	2.34400	
8	1.400	-0.00015	2.14400	
9	1.600	-0.00015	1.94400	
10	1.800	-0.00020	1.74400	
11	2.000	-0.00020	1.54400	
12	2.200	-0.00015	1.34400	
13	2.400	-0.00015	1.14400	
14	2.600	-0.00015	0.94400	
15	2.800	-0.00010	0.74400	
16	3.000	-0.00010	0.54400	
17	3.200	-0.00010	0.34400	
18	3.400	-0.00010	0.14400	
19	3.600	-0.00015	-0.05600	
20	3.800	-0.00015	-0.25600	
21	4.000	-0.00020	-0.45600	
22	4.200	-0.00020	-0.65600	
23	4.400	-0.00020	-0.85600	
24	4.600	-0.00025	-1.05600	
25	4.800	-0.00025	-1.25600	
26	5.000	-0.00025	-1.45600	
27	5.200	-0.00030	-1.65600	
28	5.400	-0.00025	-1.85600	
29	5.600	-0.00025	-2.05600	
30	5.800	-0.00020	-2.25600	
31	6.000	-0.00020	-2.45600	
32	6.200	-0.00020	-2.65600	
33	6.400	-0.00020	-2.85600	
34	6.600	-0.00015	-3.05600	
35	6.800	-0.00010	-3.25600	
36	7.000	-0.00010	-3.45600	
37	7.200	-0.00005	-3.65600	north



0.0609Ta 10/18/10

Built As
0.9800
0.9906

SHOT# 417		
A	0.9800	+.0000 −.0005
B	0.9905	+.0005 −.0000

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-048	1
1	Sabot & Flyer Plate	LGG-049	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

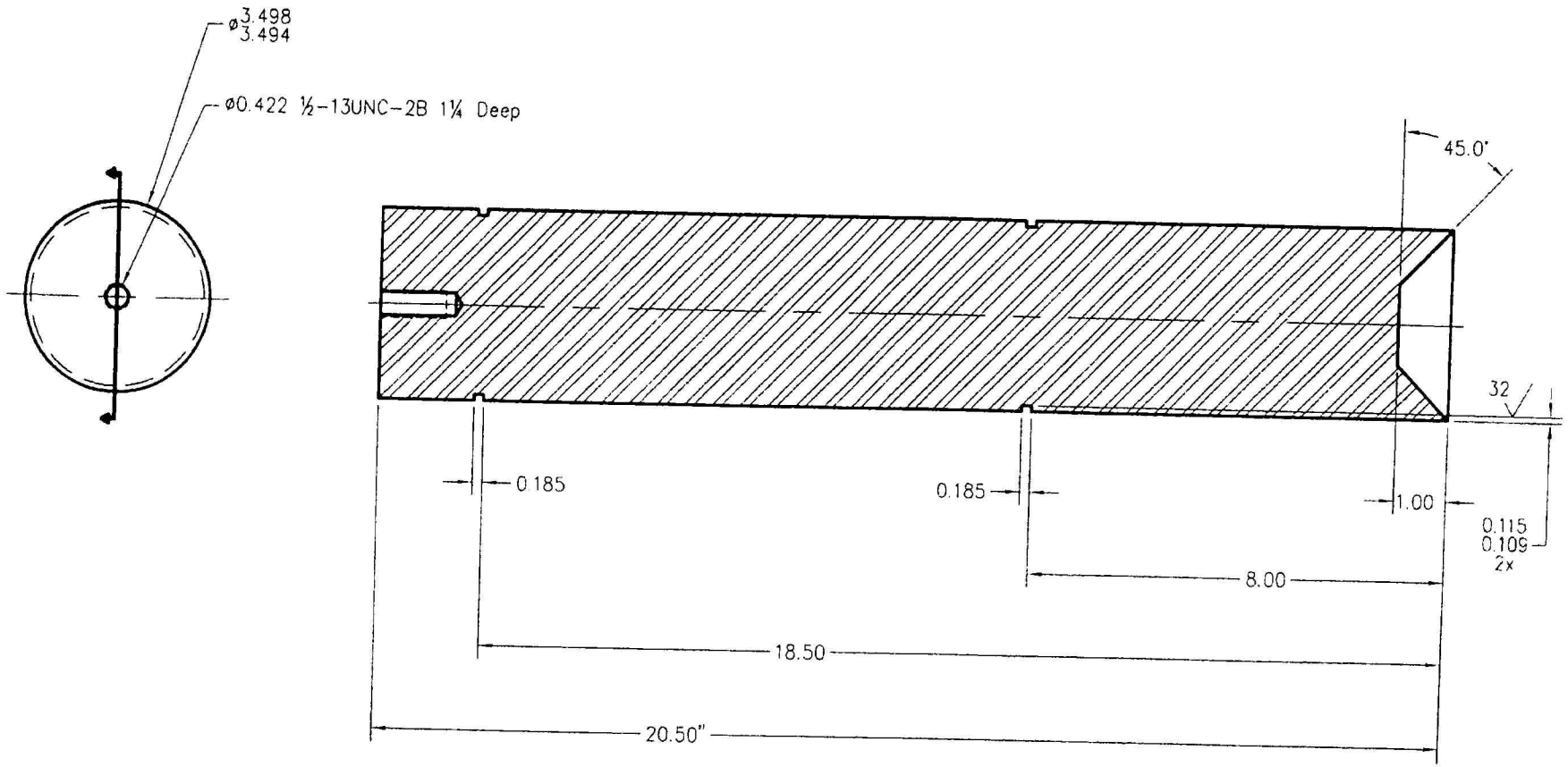
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN: M. Long — DATE: 1/23/04
ENGINEER — DATE
APPROVED — DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy.

FINISH: 16
MATERIAL: Zelux-M&HDP
SCALE: 2:1
SHEET: 2 of 2
A
DRAWING NUMBER: LGG-050



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS
FINISH 63

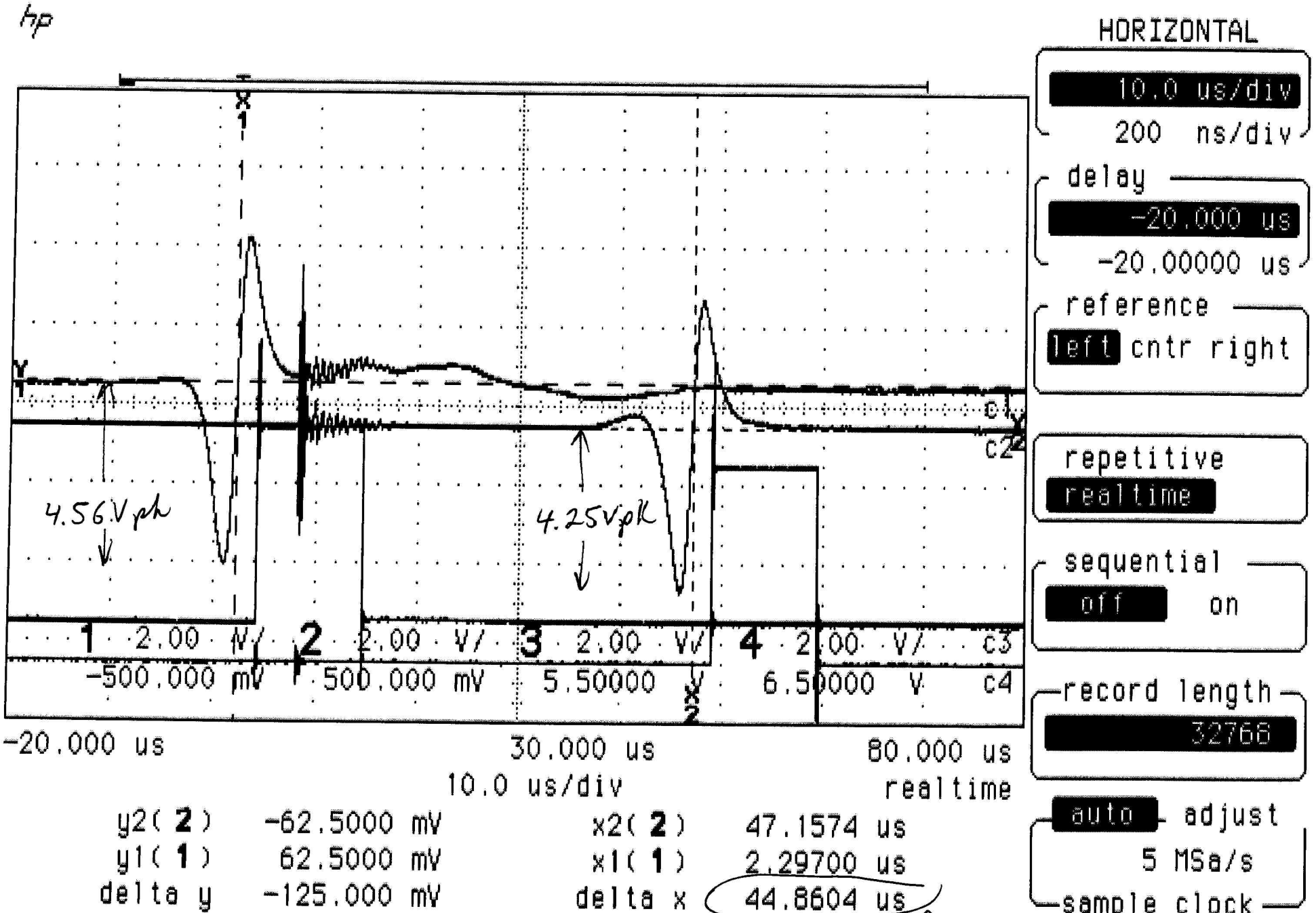
DRAWN	M. Long	DATE 10/04/01
ENGINEER		DATE
APPROVED		DATE
MATERIAL	H.D. POLY	

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: PISTON -1 Piece

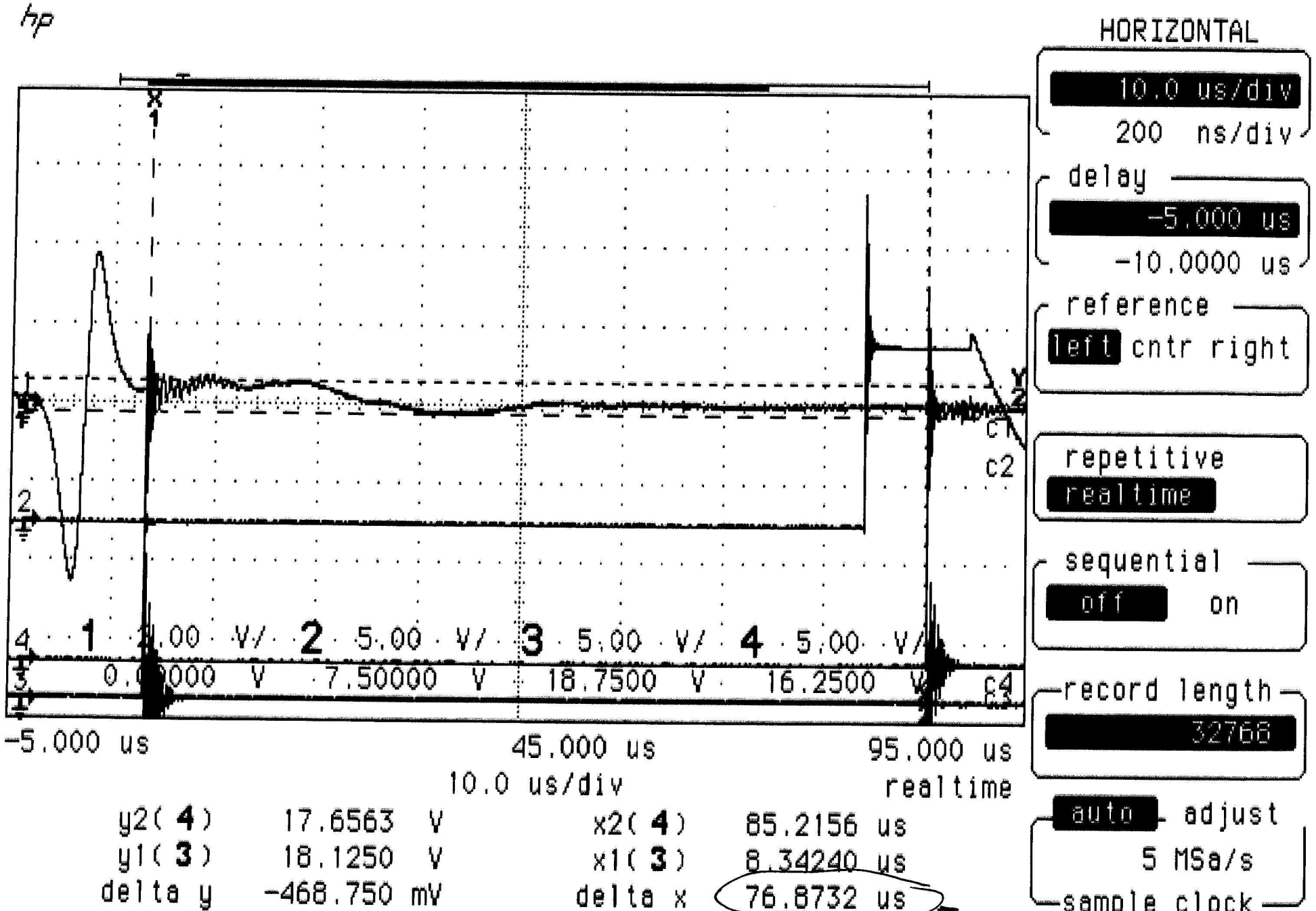
SCALE	SHEET		DRAWING NUMBER
1:2	1 of 1	B	LGG-029

Shot 417 HP5

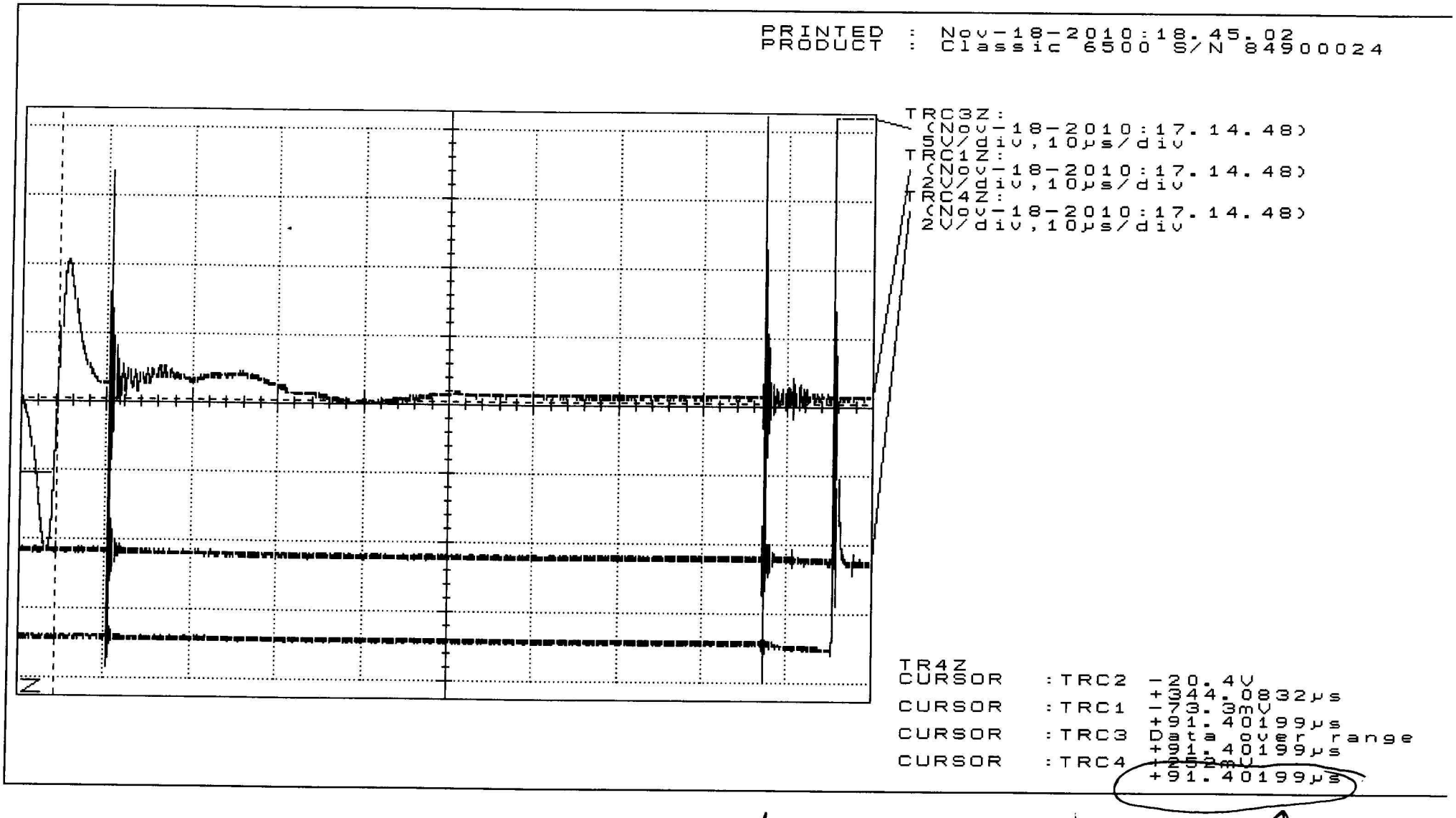


Magnet 1 to 2 interval

Shot 417 HPG


hp
HORIZONTAL
10.0 us/div
200 ns/div
delay
-5.000 us
-10.0000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32766
auto adjust
5 MSa/s
sample clock
1 5.00 V/ 2 5.00 V/ 3 5.00 V/ 4 5.00 V/
0.00000 V 7.50000 V 18.7500 V 16.2500 V
-5.000 us
45.000 us
95.000 us
10.0 us/div
realtime
y2(4) 17.6563 V
y1(3) 18.1250 V
delta y -468.750 mV
x2(4) 85.2156 us
x1(3) 8.34240 us
delta x 76.8732 us
1/delta x 13.0084 kHz
x ray 1 to 2 interval

Shot 417 GST

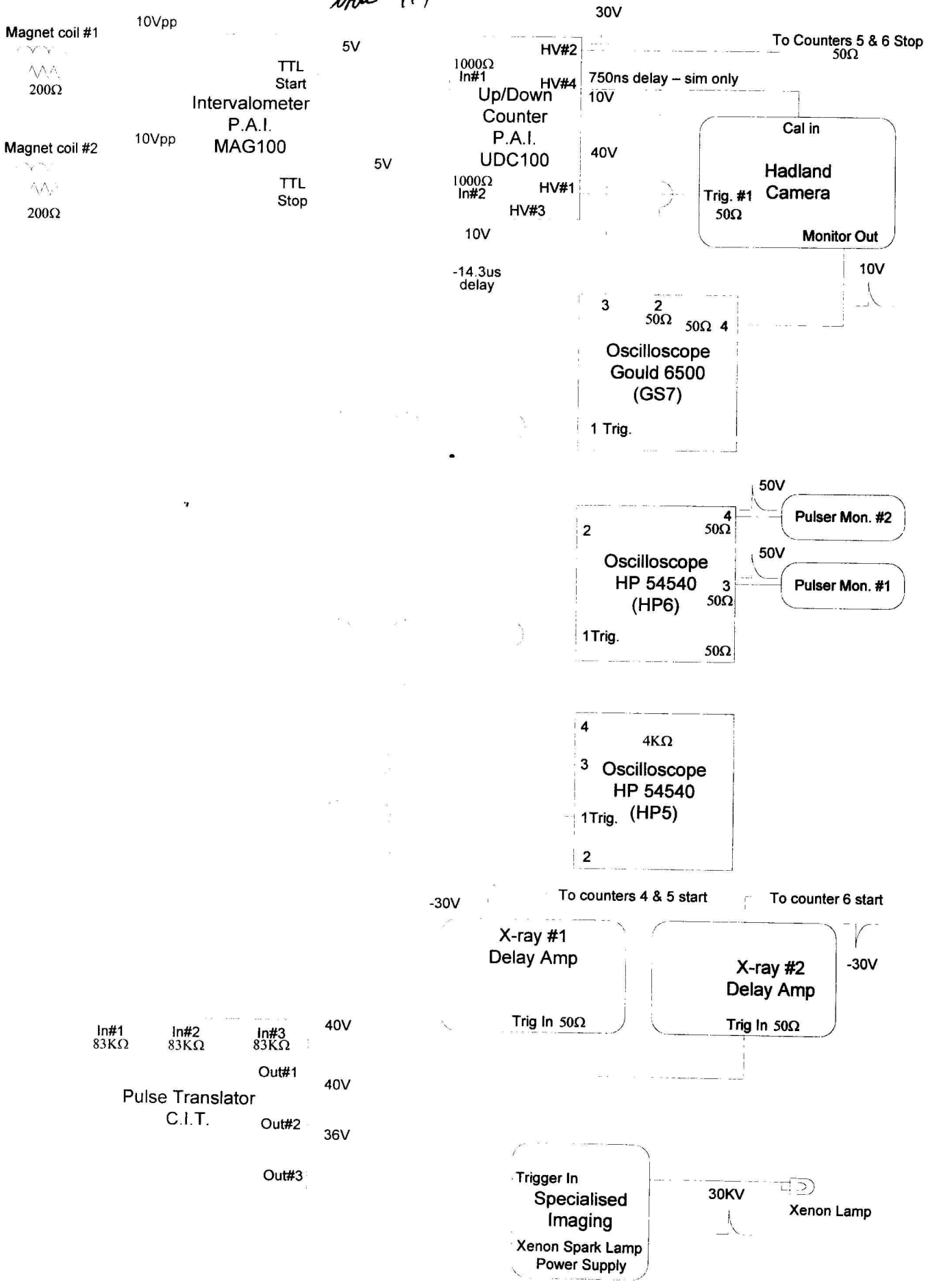


magnet 1 to camera monitor interval

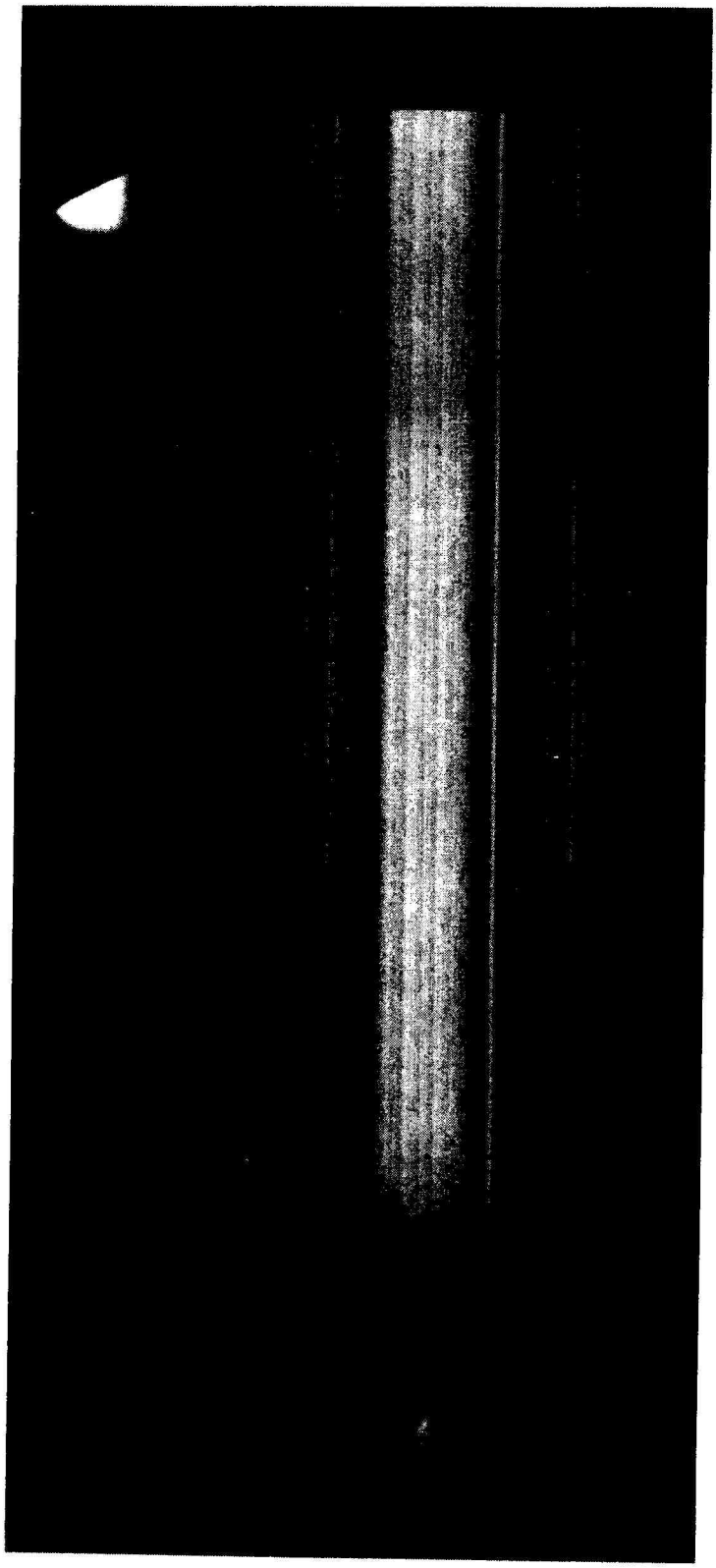
magnet 1 to camera trigger interval = 91.117 µs

Shot #413 Scope Schematic

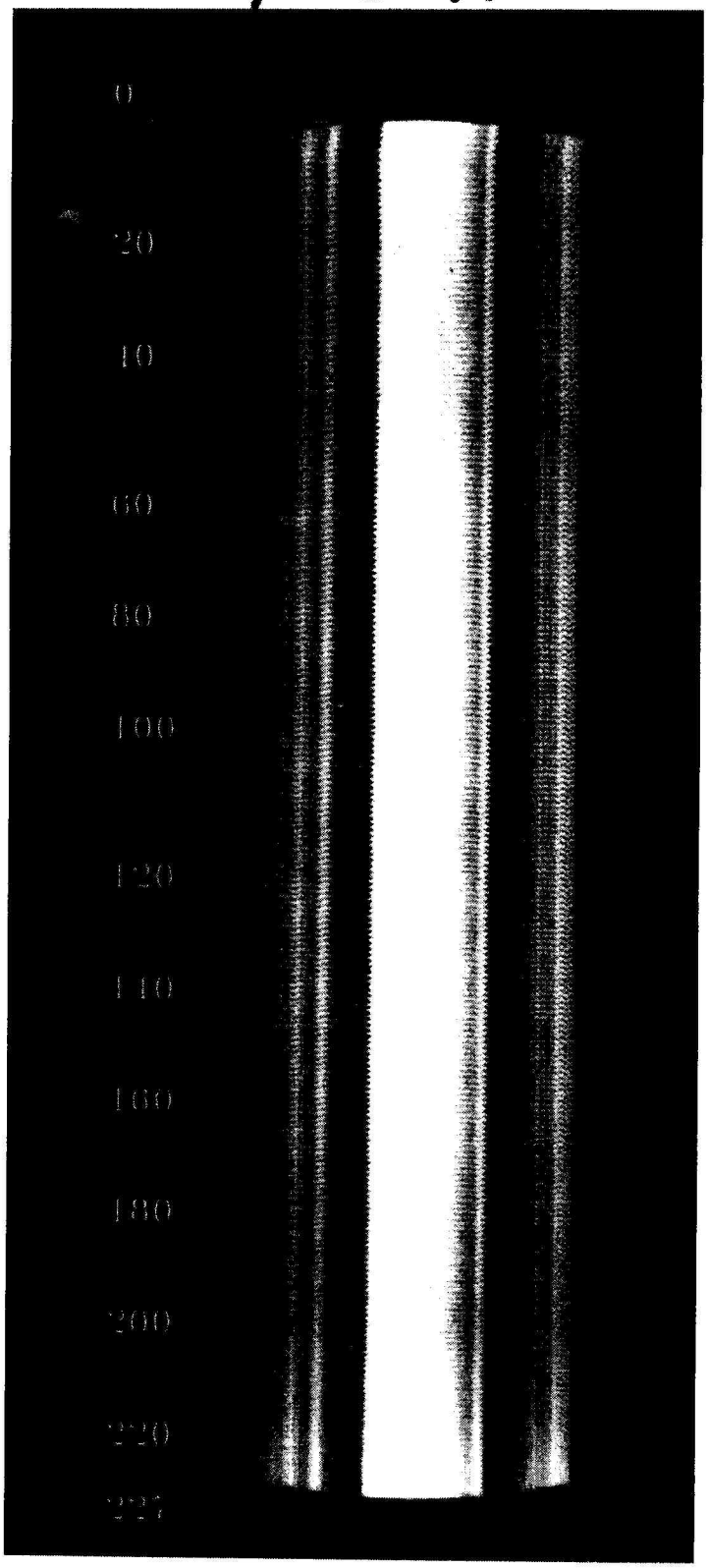
thru 417



417 Shot

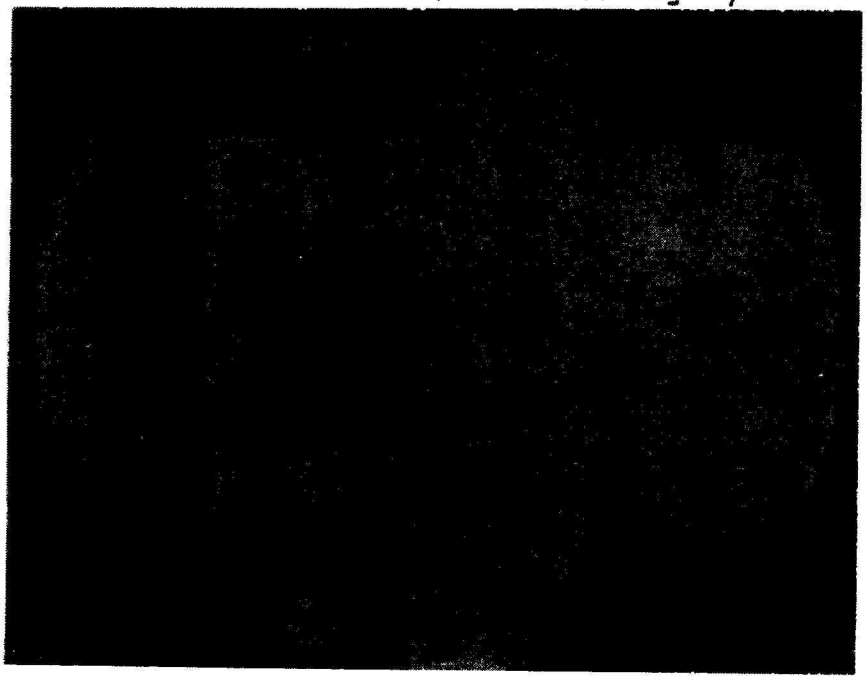


417 Cal.

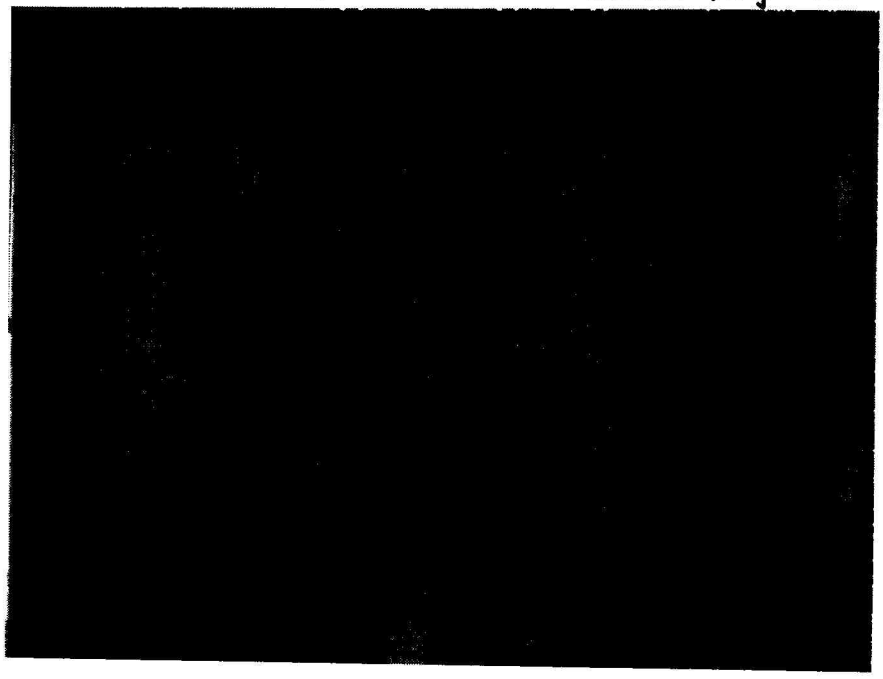


6.757 ns/pk × 227 = 1534 ns

11/18/10 LGG Shot 417 Flash Xray #1



11/18/10 LGG Shot 417 Flash Xray #2



417 Shot

LIGHT GAS GUN DATA SHEET

Shot No. 418 Date 12/3/10

Target:

Sample Material HEDENBERGITE #11 Crystallographic orientation —

Source Location UNIV. OF MICHIGAN Thickness:1 _____ in.

Type of Measurement EOS PREHEATED TO 1400°C 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height — in. Driver Plate Thickness _____ in.
(shim to driver) Material _____

Projectile:

Weight 15.266 gms. Length 0.910 in. Skirt Diameter 0.9908 in.

Flyer Plate Material Mo Leading Edge Dia. 0.9798 in.

Thickness 0.0614 in. Major Dia. 0.8132 in. Depth Inserted _____ in.

0.0614

Minor Dia. 0.75 in.

Barrel Dimensions:

Breech Diameter 0.9874 in. Muzzle Diameter 0.980 in. Taper 0.0074 in.

Ellipticity @ projectile depth insertion point 2 in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth .110 in.

Diameter: Front 3.495 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 438 gms. Type IMR 4350 Total Charge 450 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 4.2 km/sec Piston 0.49 km/sec

Notes: 1400°C at shot time
3:17 to 1400
6:20 total heating time.

L.G.G.

Camera Streak Duration: 1527 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.84

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 4.04 µsec Flash X-ray #2 88.58 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0565 in. min.	0.0921 in. min.
0.0567 in. max.	0.0935 in. max

Expected Burst Pressure 4K psi

Instrument Tank/Vacuum Pump Pressure: 60/70 µm

Distances:

Muzzle to Flash X-ray Marker #1	9.9 cm
Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
Flash X-ray Marker #2 to Target	3.78 cm
Velocity Magnet #1 to #2	20.34 cm
Piston Velocity Gauge #1 to #2	30.48 cm
Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.508 km/sec

Piston Velocity from Gauge #1 to #3: 0.502 km/sec

Projectile Velocity from UDC: 4058.34 m/sec

Projectile Velocity from X-ray: _____ km/sec

4.067

L.G.G.

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	600 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1215 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	50.2 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	84.521 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	96.127 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	11.609 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	84.504 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	50.17 µsec
UDC Velocity:			4058.34 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 ×1 2.5090	Velocity magnet 2 ×2 52.7110	50.202 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start ×3 4.5488	2.040 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop ×4 54.7060	1.995 µsec
HP6, 1-2:	Velocity Magnet 1 ×1 2.5378	Xenon Lamp Trigger ×2 90.6122	88.074 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out ×4 93.6980	84.502 µsec
GS7, 1-3:	Velocity Magnet 1 ×3 9.1958	Camera Trigger (UDC HV 1)	102.393 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	102.678 µsec

MAGNET DISTANCE

Shot No. **418** Expected Velocity: **4.20**

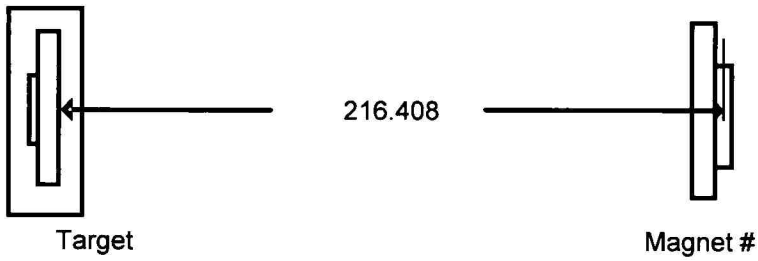
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **48.478 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.395 inch

Second measurement = 8.395 inch

Average measurement = 8.395 inch

Average measurement = 213.233 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

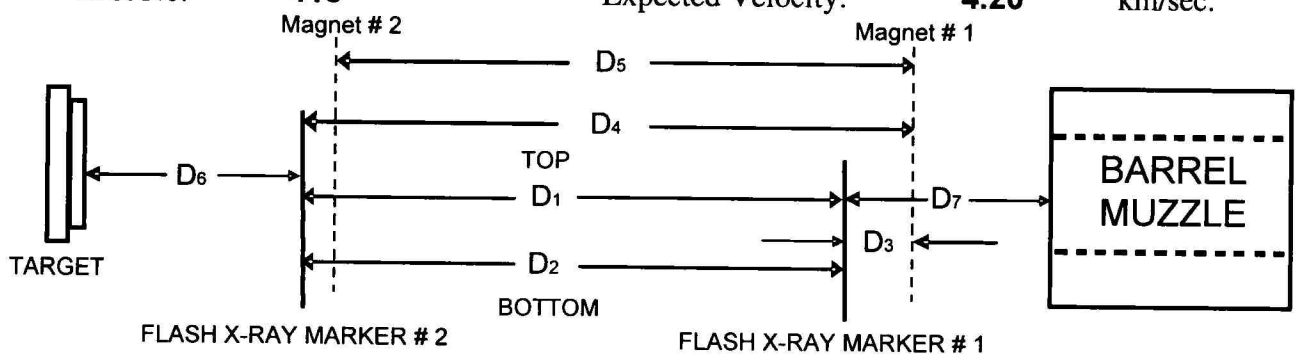
Distance Between Magnet # 2 to Target = 216.408 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **51.526 µsec.**

Fudged Distance between Magnet 2 to Target = 0 mm

TARGET MEASUREMENT

Shot No. **418** Expected Velocity: **4.20** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	38.0	99.0
Measure # 2, mm	30.00	383.15	203.66	37.5	99.0
Average, mm	30.00	383.15	203.61	37.8	99.0
Travel time, µsec	**7.14**	**91.23**	**48.48**	**8.99**	**23.57**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **84.10** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **84.07** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **4.04** µsec.

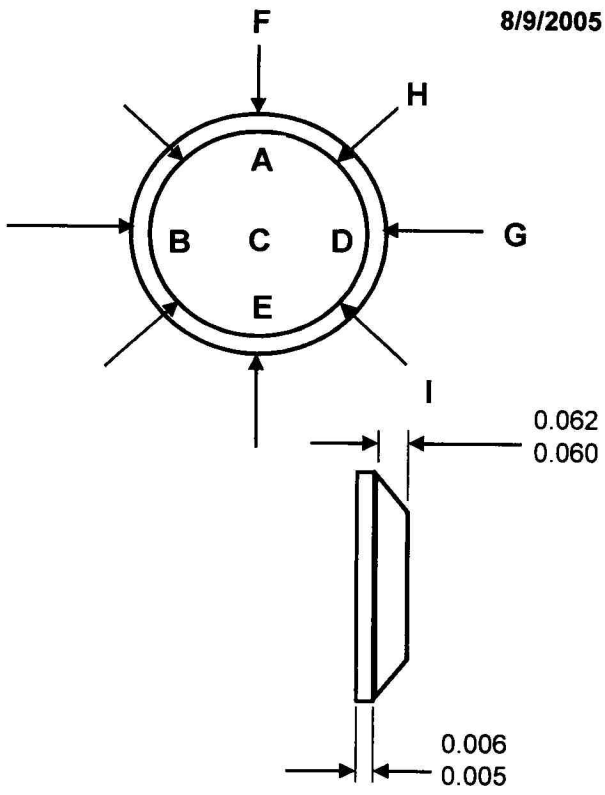
Flash X-Ray # 2 Delay (from Magnet # 1) **88.58** µsec.

SHOT No. **418**

FLYER PLATE MATERIAL: **molybdenum** disk 3

Measurement done by: Russ **8/9/2005**

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06015	F	0.81250
A	0.06015	F	0.81400
B	0.06060	G	0.81300
B	0.06040	G	0.81050
C	0.06020	H	0.75250
C	0.06000	H	0.75350
D	0.05975	I	0.75500
D	0.05970	I	0.75450
E	0.06055		
E	0.06030		



Statistic for thickness

N	10
MAX	0.06060
MIN	0.05970
Range	0.00090
MEAN	0.060114286
STDEV	0.000327509

Statistic for Diameter (F-G)

N	4
MAX	0.81400
MIN	0.81050
Range	0.00350
MEAN	0.8125000
STDEV	0.00147196

Statistic for Diameter (H-I)

N	4
MAX	0.75500
MIN	0.75250
Range	0.00250
MEAN	0.753875
STDEV	0.001108678

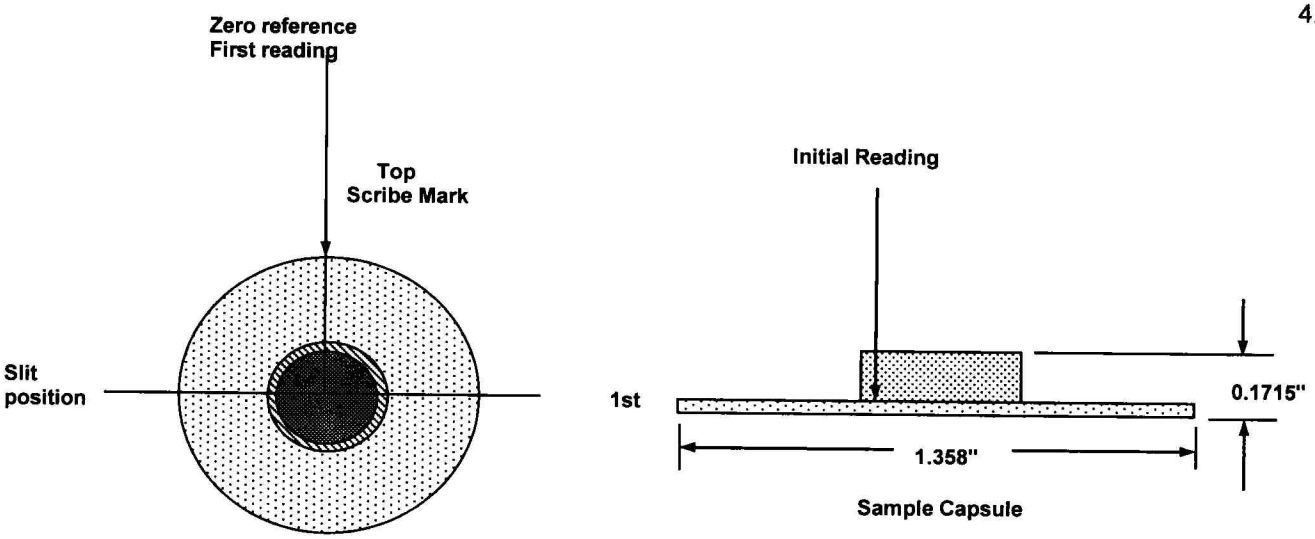
DENSITY MEASUREMENT BY:			Russ		on: Aug. 9 ,05	
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	19.7	1.88889	4.86315	6.37500	0.8625	11.1247
2	19.7	1.88883	4.86318	6.37505	0.8625	11.1272
3	19.7	1.88890	4.8632	6.37498	0.8625	11.1225
	THICKNESS		0.060114286	±	in	
	FLATNESS:		0.0009	in.		
	VOLUME:		0.5108	5.35E-03	cm^3	
	CRYSTAL DENSITY:		11.1248	2.34E-03	$grams/cm^3$	
	BULK DENSITY:		9.5215	5.35E-03	$grams/cm^3$	
	DENSITIES CHECKED BY: _		Russ	8/9/05		
	MEASUREMENT CHECKED		Russ	8/9/2005		

#3 - sample - molybdenum - Flyer Plate. - standard LGG Shot # 418

SAMPLE CAPSULE: **11** 6/7/2010
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.592
4.713

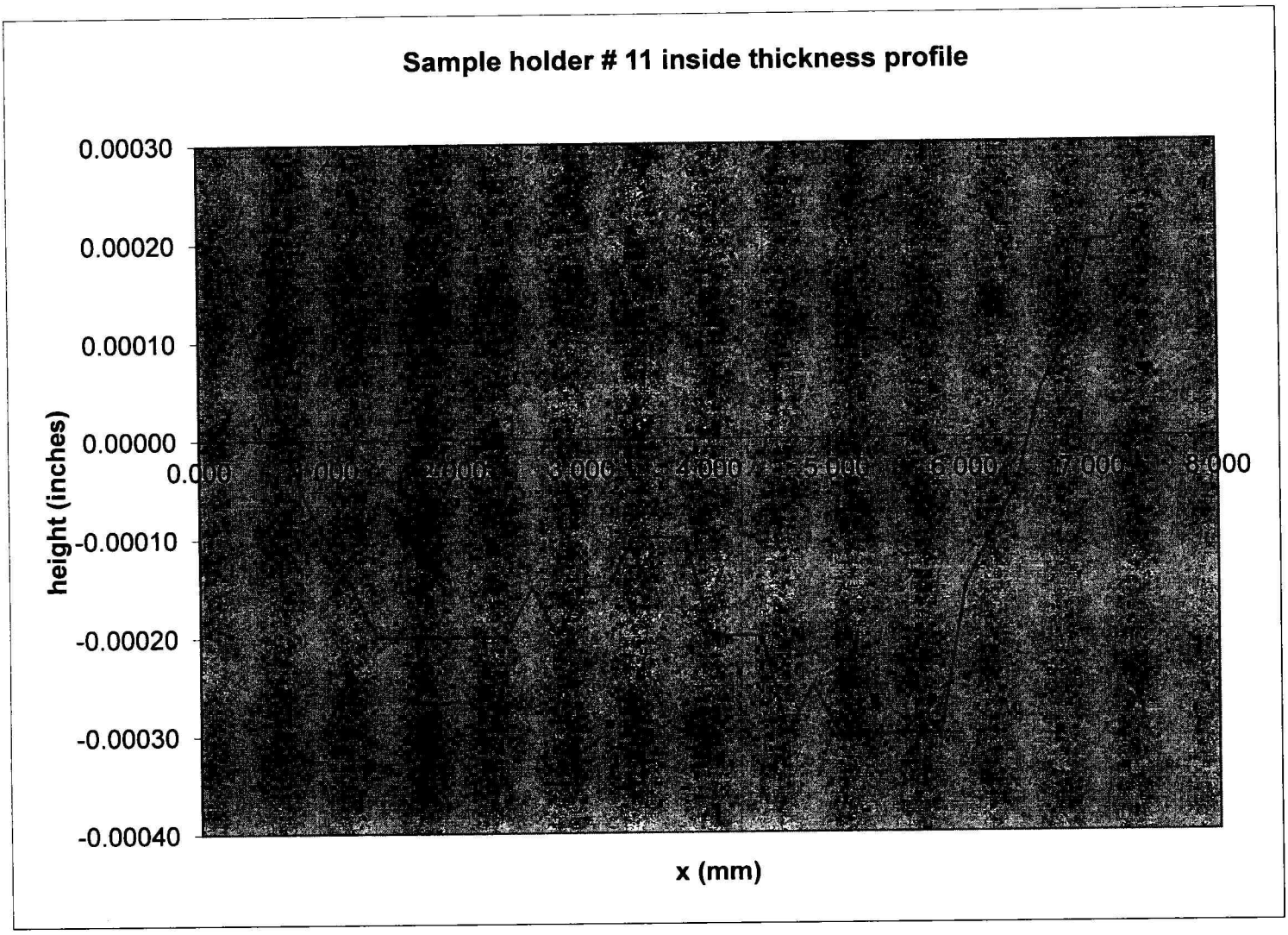


1.338582677

Average thickness reading = 0.00020

Note: The thickness of the reference zero point from the base is = 0.04185 Inches
1.06299 mm

error on the measurement, assume the profile is symmeteric -- >


Sample holder # 11 inside thickness profile
0.00030
0.00020
0.00010
0.00000
-0.00010
-0.00020
-0.00030
-0.00040
height (inches)
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

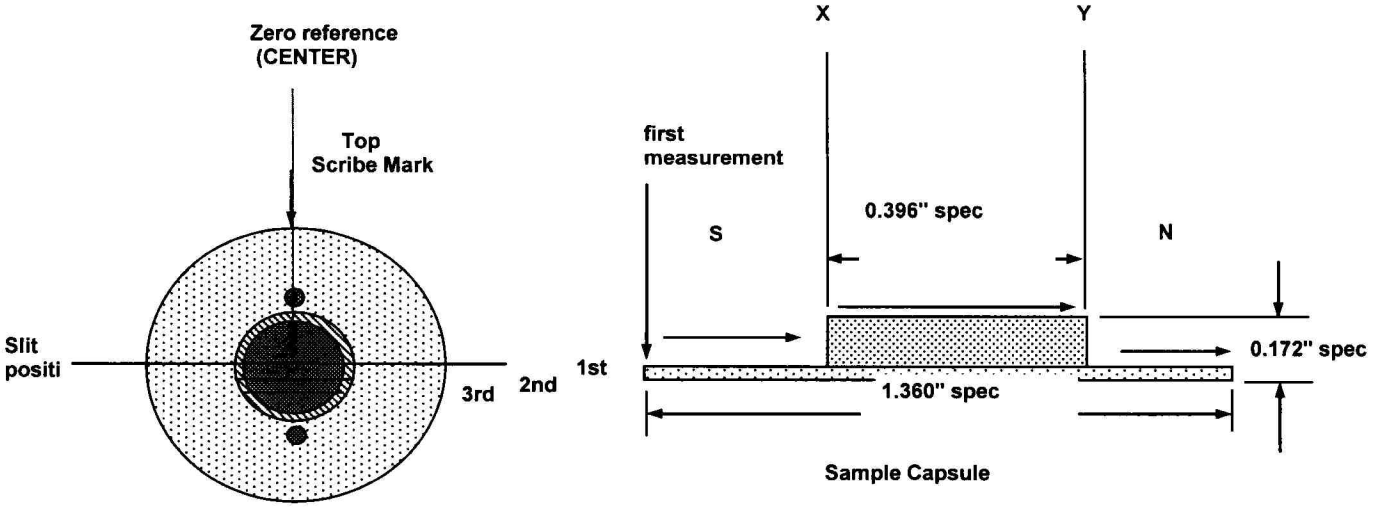
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00020	3.576	south
2	0.200	0.00020	3.37600	
3	0.400	0.00010	3.17600	
4	0.600	0.00005	2.97600	
5	0.800	-0.00005	2.77600	
6	1.000	-0.00010	2.57600	
7	1.200	-0.00015	2.37600	
8	1.400	-0.00020	2.17600	
9	1.600	-0.00020	1.97600	
10	1.800	-0.00020	1.77600	
11	2.000	-0.00020	1.57600	
12	2.200	-0.00020	1.37600	
13	2.400	-0.00020	1.17600	
14	2.600	-0.00015	0.97600	
15	2.800	-0.00020	0.77600	
16	3.000	-0.00015	0.57600	
17	3.200	-0.00015	0.37600	
18	3.400	-0.00010	0.17600	
19	3.600	-0.00010	-0.02400	
20	3.800	-0.00010	-0.22400	
21	4.000	-0.00020	-0.42400	
22	4.200	-0.00020	-0.62400	
23	4.400	-0.00020	-0.82400	
24	4.600	-0.00030	-1.02400	
25	4.800	-0.00025	-1.22400	
26	5.000	-0.00030	-1.42400	
27	5.200	-0.00030	-1.62400	
28	5.400	-0.00030	-1.82400	
29	5.600	-0.00030	-2.02400	
30	5.800	-0.00030	-2.22400	
31	6.000	-0.00015	-2.42400	
32	6.200	-0.00010	-2.62400	
33	6.400	-0.00005	-2.82400	
34	6.600	0.00005	-3.02400	
35	6.800	0.00010	-3.22400	
36	7.000	0.00020	-3.42400	
37	7.200	0.00020	-3.62400	north

SHOT No. 418
SAMPLE CAPSULE: # 11
SAMPLE MATERIAL: Hedenbergite

tip used: .7mm long/ flat tip
note: the platform on which the measurement was taken deviates from flat by +0.013 max.
direction of measurement

4.601
4.661

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = -0.00013

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = -0.00293

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = -0.00300

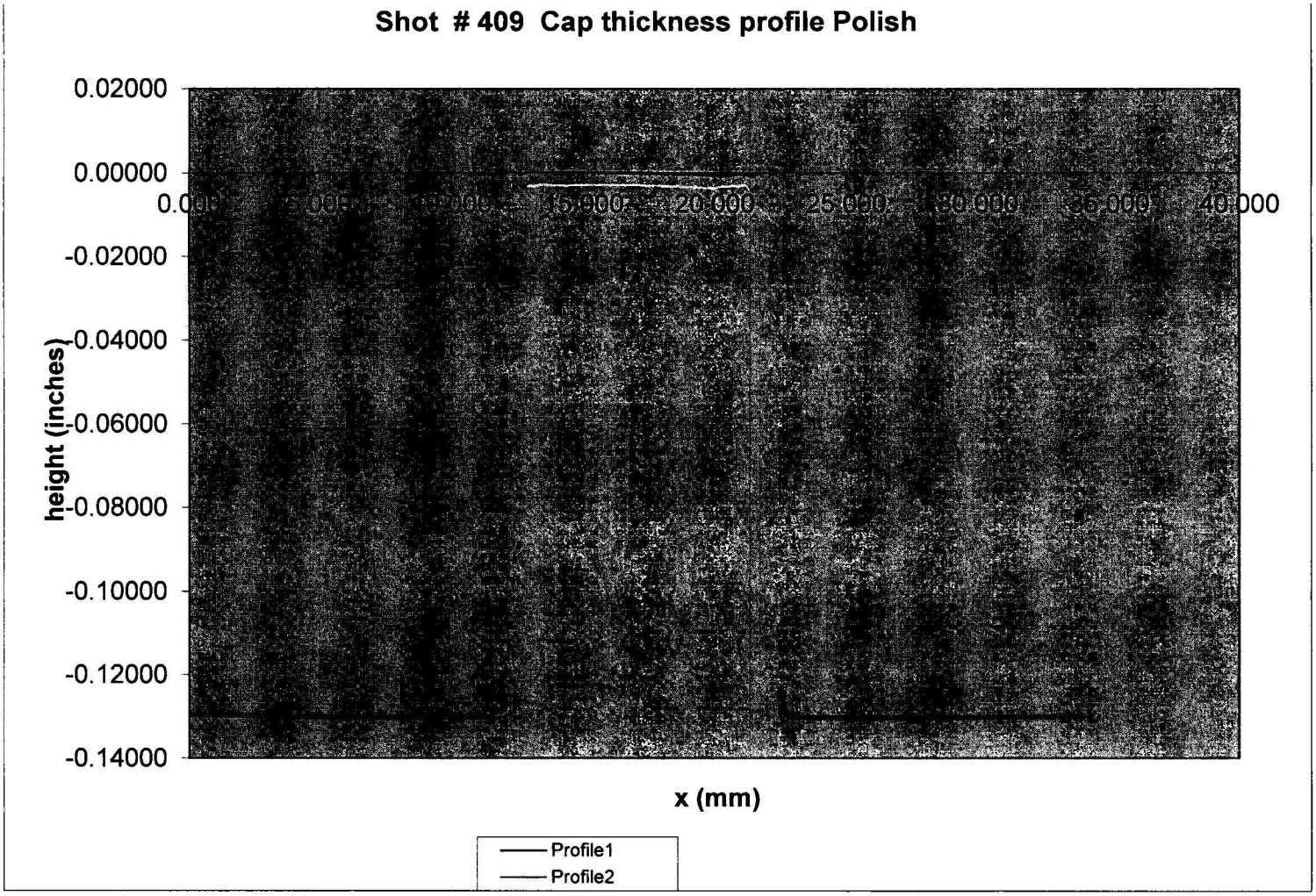
Note: Measurement from reference zero point from the base is = 0.1752 Inches
4.4508 mm

Average thickness of the driver Plate = 0.0452 Inches
1.1493 mm

Thickness of the Carbon Deposited on the coil side is = (85 + 36.8 nm) → recoat due to peeling = 121.8 **nm**

Thickness of the Carbon Deposited on the Projectile side is = 85.4 **nm**

Distance from the top of the cap to the measured (avg) driver plate **0.13** Inches
3.30 mm


Shot # 409 Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
height (inches)
15.000
20.000
25.000
30.000
35.000
40.000
x (mm)
Profile1
Profile2

1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

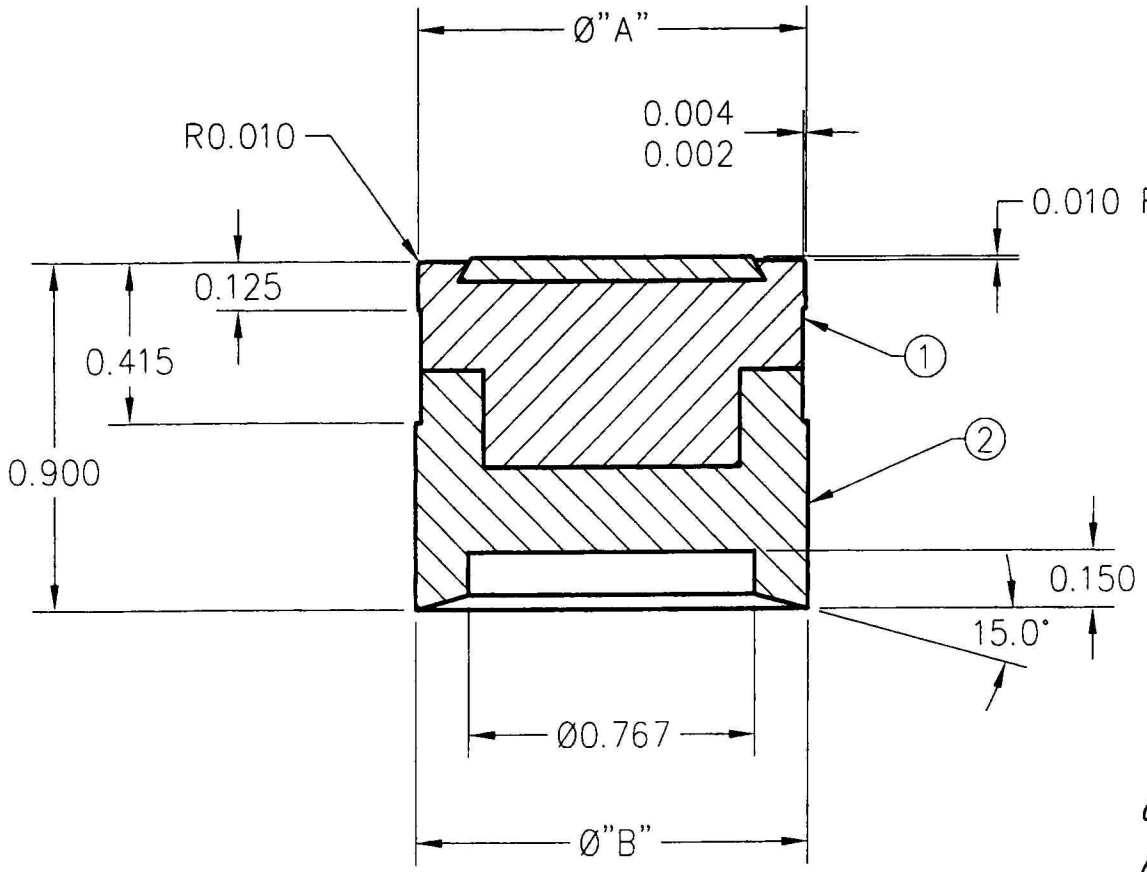
Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading	Reading Distance mm
1	0.000	17.000	-0.1299	225	22.400	-5.400	-0.1246	118	11.700
2	0.100	16.900	-0.1296	226	22.500	-5.500	-0.1232	119	11.800
3	0.200	16.800	-0.1295	227	22.600	-5.600	-0.1270	120	11.900
4	0.300	16.700	-0.1295	228	22.700	-5.700	-0.1294	121	12.000
5	0.400	16.600	-0.1295	229	22.800	-5.800	-0.1300	122	12.100
6	0.500	16.500	-0.1295	230	22.900	-5.900	-0.1300	123	12.200
7	0.600	16.400	-0.1295	231	23.000	-6.000	-0.1301	124	12.300
8	0.700	16.300	-0.1296	232	23.100	-6.100	-0.1301	125	12.400
9	0.800	16.200	-0.1295	233	23.200	-6.200	-0.1301	126	12.500
10	0.900	16.100	-0.1296	234	23.300	-6.300	-0.1301	127	12.600
11	1.000	16.000	-0.1295	235	23.400	-6.400	-0.1301	128	12.700
12	1.100	15.900	-0.1296	236	23.500	-6.500	-0.1301	129	12.800
13	1.200	15.800	-0.1296	237	23.600	-6.600	-0.1301	130	12.900
14	1.300	15.700	-0.1296	238	23.700	-6.700	-0.1302	131	13.000
15	1.400	15.600	-0.1296	239	23.800	-6.800	-0.1302	132	13.100
16	1.500	15.500	-0.1296	240	23.900	-6.900	-0.1302	133	13.200
17	1.600	15.400	-0.1296	241	24.000	-7.000	-0.1302	134	13.300
18	1.700	15.300	-0.1296	242	24.100	-7.100	-0.1303	135	13.400
19	1.800	15.200	-0.1297	243	24.200	-7.200	-0.1302	136	13.500
20	1.900	15.100	-0.1296	244	24.300	-7.300	-0.1303	137	13.600
21	2.000	15.000	-0.1297	245	24.400	-7.400	-0.1303	138	13.700
22	2.100	14.900	-0.1297	246	24.500	-7.500	-0.1303	139	13.800
23	2.200	14.800	-0.1297	247	24.600	-7.600	-0.1303	140	13.900
24	2.300	14.700	-0.1297	248	24.700	-7.700	-0.1303	141	14.000
25	2.400	14.600	-0.1298	249	24.800	-7.800	-0.1303	142	14.100
26	2.500	14.500	-0.1298	250	24.900	-7.900	-0.1303	143	14.200
27	2.600	14.400	-0.1298	251	25.000	-8.000	-0.1303	144	14.300
28	2.700	14.300	-0.1298	252	25.100	-8.100	-0.1303	145	14.400
29	2.800	14.200	-0.1298	253	25.200	-8.200	-0.1303	146	14.500
30	2.900	14.100	-0.1298	254	25.300	-8.300	-0.1303	147	14.600
31	3.000	14.000	-0.1298	255	25.400	-8.400	-0.1303	148	14.700
32	3.100	13.900	-0.1298	256	25.500	-8.500	-0.1303	149	14.800
33	3.200	13.800	-0.1299	257	25.600	-8.600	-0.1304	150	14.900
34	3.300	13.700	-0.1299	258	25.700	-8.700	-0.1303	151	15.000
35	3.400	13.600	-0.1299	259	25.800	-8.800	-0.1303	152	15.100
36	3.500	13.500	-0.1299	260	25.900	-8.900	-0.1303	153	15.200
37	3.600	13.400	-0.1299	261	26.000	-9.000	-0.1304	154	15.300
38	3.700	13.300	-0.1299	262	26.100	-9.100	-0.1303	155	15.400
39	3.800	13.200	-0.1299	263	26.200	-9.200	-0.1303	156	15.500
40	3.900	13.100	-0.1299	264	26.300	-9.300	-0.1303	157	15.600
41	4.000	13.000	-0.1299	265	26.400	-9.400	-0.1303	158	15.700
42	4.100	12.900	-0.1299	266	26.500	-9.500	-0.1303	159	15.800
43	4.200	12.800	-0.1300	267	26.600	-9.600	-0.1303	160	15.900
44	4.300	12.700	-0.1299	268	26.700	-9.700	-0.1303	161	16.000
45	4.400	12.600	-0.1299	269	26.800	-9.800	-0.1303	162	16.100
46	4.500	12.500	-0.1300	270	26.900	-9.900	-0.1303	163	16.200
47	4.600	12.400	-0.1300	271	27.000	-10.000	-0.1303	164	16.300
48	4.700	12.300	-0.1300	272	27.100	-10.100	-0.1303	165	16.400
49	4.800	12.200	-0.1300	273	27.200	-10.200	-0.1303	166	16.500
50	4.900	12.100	-0.1300	274	27.300	-10.300	-0.1303	167	16.600
51	5.000	12.000	-0.1300	275	27.400	-10.400	-0.1303	168	16.700
52	5.100	11.900	-0.1301	276	27.500	-10.500	-0.1303	169	16.800

53	5.200	11.800	-0.1301	277	27.600	-10.600	-0.1303	170	16.900
54	5.300	11.700	-0.1300	278	27.700	-10.700	-0.1303	171	17.000
55	5.400	11.600	-0.1301	279	27.800	-10.800	-0.1303	172	17.100
56	5.500	11.500	-0.1301	280	27.900	-10.900	-0.1303	173	17.200
57	5.600	11.400	-0.1301	281	28.000	-11.000	-0.1302	174	17.300
58	5.700	11.300	-0.1301	282	28.100	-11.100	-0.1303	175	17.400
59	5.800	11.200	-0.1301	283	28.200	-11.200	-0.1303	176	17.500
60	5.900	11.100	-0.1301	284	28.300	-11.300	-0.1302	177	17.600
61	6.000	11.000	-0.1301	285	28.400	-11.400	-0.1302	178	17.700
62	6.100	10.900	-0.1301	286	28.500	-11.500	-0.1303	179	17.800
63	6.200	10.800	-0.1301	287	28.600	-11.600	-0.1302	180	17.900
64	6.300	10.700	-0.1301	288	28.700	-11.700	-0.1303	181	18.000
65	6.400	10.600	-0.1302	289	28.800	-11.800	-0.1303	182	18.100
66	6.500	10.500	-0.1302	290	28.900	-11.900	-0.1303	183	18.200
67	6.600	10.400	-0.1301	291	29.000	-12.000	-0.1302	184	18.300
68	6.700	10.300	-0.1301	292	29.100	-12.100	-0.1302	185	18.400
69	6.800	10.200	-0.1302	293	29.200	-12.200	-0.1302	186	18.500
70	6.900	10.100	-0.1302	294	29.300	-12.300	-0.1302	187	18.600
71	7.000	10.000	-0.1302	295	29.400	-12.400	-0.1302	188	18.700
72	7.100	9.900	-0.1302	296	29.500	-12.500	-0.1302	189	18.800
73	7.200	9.800	-0.1302	297	29.600	-12.600	-0.1302	190	18.900
74	7.300	9.700	-0.1302	298	29.700	-12.700	-0.1302	191	19.000
75	7.400	9.600	-0.1301	299	29.800	-12.800	-0.1302	192	19.100
76	7.500	9.500	-0.1302	300	29.900	-12.900	-0.1302	193	19.200
77	7.600	9.400	-0.1302	301	30.000	-13.000	-0.1301	194	19.300
78	7.700	9.300	-0.1301	302	30.100	-13.100	-0.1302	195	19.400
79	7.800	9.200	-0.1302	303	30.200	-13.200	-0.1302	196	19.500
80	7.900	9.100	-0.1302	304	30.300	-13.300	-0.1301	197	19.600
81	8.000	9.000	-0.1302	305	30.400	-13.400	-0.1301	198	19.700
82	8.100	8.900	-0.1301	306	30.500	-13.500	-0.1301	199	19.800
83	8.200	8.800	-0.1302	307	30.600	-13.600	-0.1301	200	19.900
84	8.300	8.700	-0.1302	308	30.700	-13.700	-0.1301	201	20.000
85	8.400	8.600	-0.1301	309	30.800	-13.800	-0.1300	202	20.100
86	8.500	8.500	-0.1301	310	30.900	-13.900	-0.1301	203	20.200
87	8.600	8.400	-0.1302	311	31.000	-14.000	-0.1300	204	20.300
88	8.700	8.300	-0.1301	312	31.100	-14.100	-0.1300	205	20.400
89	8.800	8.200	-0.1302	313	31.200	-14.200	-0.1300	206	20.500
90	8.900	8.100	-0.1302	314	31.300	-14.300	-0.1300	207	20.600
91	9.000	8.000	-0.1302	315	31.400	-14.400	-0.1300	208	20.700
92	9.100	7.900	-0.1302	316	31.500	-14.500	-0.1300	209	20.800
93	9.200	7.800	-0.1301	317	31.600	-14.600	-0.1300	210	20.900
94	9.300	7.700	-0.1302	318	31.700	-14.700	-0.1300	211	21.000
95	9.400	7.600	-0.1302	319	31.800	-14.800	-0.1300	212	21.100
96	9.500	7.500	-0.1301	320	31.900	-14.900	-0.1300	213	21.200
97	9.600	7.400	-0.1301	321	32.000	-15.000	-0.1300	214	21.300
98	9.700	7.300	-0.1301	322	32.100	-15.100	-0.1300	215	21.400
99	9.800	7.200	-0.1301	323	32.200	-15.200	-0.1300	216	21.500
100	9.900	7.100	-0.1301	324	32.300	-15.300	-0.1299	217	21.600
101	10.000	7.000	-0.1301	325	32.400	-15.400	-0.1299	218	21.700
102	10.100	6.900	-0.1301	326	32.500	-15.500	-0.1299	219	21.800
103	10.200	6.800	-0.1301	327	32.600	-15.600	-0.1300	220	21.900
104	10.300	6.700	-0.1300	328	32.700	-15.700	-0.1300	221	22.000
105	10.400	6.600	-0.1300	329	32.800	-15.800	-0.1300	222	22.100
106	10.500	6.500	-0.1301	330	32.900	-15.900	-0.1299	223	22.200
107	10.600	6.400	-0.1301	331	33.000	-16.000	-0.1299	224	22.300
108	10.700	6.300	-0.1300	332	33.100	-16.100	-0.1299		
109	10.800	6.200	-0.1300	333	33.200	-16.200	-0.1298		
110	10.900	6.100	-0.1300	334	33.300	-16.300	-0.1298		
111	11.000	6.000	-0.1300	335	33.400	-16.400	-0.1298		
112	11.100	5.900	-0.1300	336	33.500	-16.500	-0.1299		

113	11.200	5.800	-0.1299	337	33.600	-16.600	-0.1299
114	11.300	5.700	-0.1300	338	33.700	-16.700	-0.1300
115	11.400	5.600	-0.1300	339	33.800	-16.800	-0.1300
116	11.500	5.500	-0.1299	340	33.900	-16.900	-0.1301
117	11.600	5.400	-0.1288	341	34.000	-17.000	-0.1302

	1st	2nd	3 rd
abs dist.	Run	Run	Run
	Reading	Reading	Reading
mm	Inches	Inches	Inches
5.300			
5.200			
5.100			
5.000			
4.900			
4.800			
4.700	0.00032		
4.600	0.00011		
4.500	0.00004	-0.00249	
4.400	-0.00022	-0.00296	
4.300	-0.00023	-0.00319	
4.200	0.00011	-0.00281	
4.100	0.00024	-0.00234	-0.00304
4.000	0.00023	-0.00221	-0.00306
3.900	0.00022	-0.00219	-0.00319
3.800	0.00016	-0.00232	-0.00312
3.700	0.00009	-0.00239	-0.00279
3.600	0.00013	-0.00242	-0.00267
3.500	0.00012	-0.00244	-0.00269
3.400	0.00010	-0.00247	-0.00272
3.300	0.00009	-0.00249	-0.00274
3.200	0.00013	-0.00247	-0.00277
3.100	0.00007	-0.00254	-0.00289
3.000	0.00010	-0.00247	-0.00282
2.900	0.00009	-0.00250	-0.00290
2.800	0.00008	-0.00252	-0.00287
2.700	0.00006	-0.00255	-0.00290
2.600	0.00010	-0.00252	-0.00287
2.500	0.00009	-0.00250	-0.00280
2.400	0.00007	-0.00253	-0.00283
2.300	0.00006	-0.00255	-0.00285
2.200	0.00010	-0.00253	-0.00283
2.100	0.00009	-0.00251	-0.00281
2.000	0.00007	-0.00253	-0.00283
1.900	0.00011	-0.00251	-0.00276
1.800	0.00010	-0.00254	-0.00279
1.700	0.00008	-0.00251	-0.00276
1.600	0.00007	-0.00254	-0.00279
1.500	0.00006	-0.00257	-0.00282
1.400	0.00004	-0.00259	-0.00279
1.300	0.00008	-0.00257	-0.00277
1.200	0.00007	-0.00255	-0.00275
1.100	0.00005	-0.00257	-0.00277
1.000	0.00004	-0.00260	-0.00280
0.900	0.00002	-0.00263	-0.00283
0.800	0.00001	-0.00266	-0.00281
0.700	0.00005	-0.00258	-0.00273
0.600	0.00003	-0.00266	-0.00281
0.500	0.00002	-0.00264	-0.00279
0.400	0.00001	-0.00272	-0.00287
0.300	-0.00001	-0.00269	-0.00284
0.200 7	-0.00002	-0.00272	-0.00282

0.100	-0.00004	-0.00275	-0.00285
0.000	0.00000	-0.00273	-0.00283
-0.100	-0.00001	-0.00275	-0.00285
-0.200	-0.00003	-0.00278	-0.00288
-0.300	-0.00004	-0.00276	-0.00286
-0.400	-0.00006	-0.00284	-0.00294
-0.500	-0.00007	-0.00282	-0.00292
-0.600	-0.00008	-0.00285	-0.00295
-0.700	-0.00010	-0.00287	-0.00297
-0.800	-0.00011	-0.00290	-0.00300
-0.900	-0.00013	-0.00293	-0.00303
-1.000	-0.00014	-0.00296	-0.00306
-1.100	-0.00016	-0.00299	-0.00309
-1.200	-0.00017	-0.00302	-0.00307
-1.300	-0.00019	-0.00305	-0.00310
-1.400	-0.00020	-0.00308	-0.00313
-1.500	-0.00021	-0.00311	-0.00316
-1.600	-0.00023	-0.00313	-0.00318
-1.700	-0.00024	-0.00316	-0.00321
-1.800	-0.00026	-0.00319	-0.00324
-1.900	-0.00027	-0.00322	-0.00327
-2.000	-0.00029	-0.00325	-0.00330
-2.100	-0.00030	-0.00333	-0.00338
-2.200	-0.00032	-0.00336	-0.00341
-2.300	-0.00033	-0.00339	-0.00344
-2.400	-0.00035	-0.00342	-0.00347
-2.500	-0.00036	-0.00340	-0.00345
-2.600	-0.00038	-0.00348	-0.00353
-2.700	-0.00044	-0.00356	-0.00361
-2.800	-0.00046	-0.00359	-0.00364
-2.900	-0.00047	-0.00362	-0.00362
-3.000	-0.00049	-0.00365	-0.00360
-3.100	-0.00050	-0.00368	-0.00353
-3.200	-0.00052	-0.00371	-0.00341
-3.300	-0.00053	-0.00374	-0.00334
-3.400	-0.00055	-0.00372	-0.00327
-3.500	-0.00056	-0.00370	-0.00325
-3.600	-0.00058	-0.00368	-0.00323
-3.700	-0.00049	-0.00346	-0.00311
-3.800	-0.00041	-0.00324	-0.00314
-3.900	-0.00032	-0.00323	-0.00328
-4.000	-0.00029	-0.00321	-0.00311
-4.100	-0.00036	-0.00339	-0.00304
-4.200	-0.00042	-0.00372	-0.00297
-4.300	-0.00064	-0.00405	-0.00405
-4.400	-0.00080	-0.00403	
-4.500	-0.00062	-0.00341	
-4.600	-0.00043	-0.00379	
-4.700	0.00005		
-4.800	-0.00071		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			0.00000



as built Mo 0.0614 9/28/09

0.9798

0.9908

SHOT# 418		
A	0.9800	+.0000 −.0005
B	0.9905	+.0005 −.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-048	1
1	Sabot & Flyer Plate	LGG-049	1

Note: Super Glue & Press Fit 1 & 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

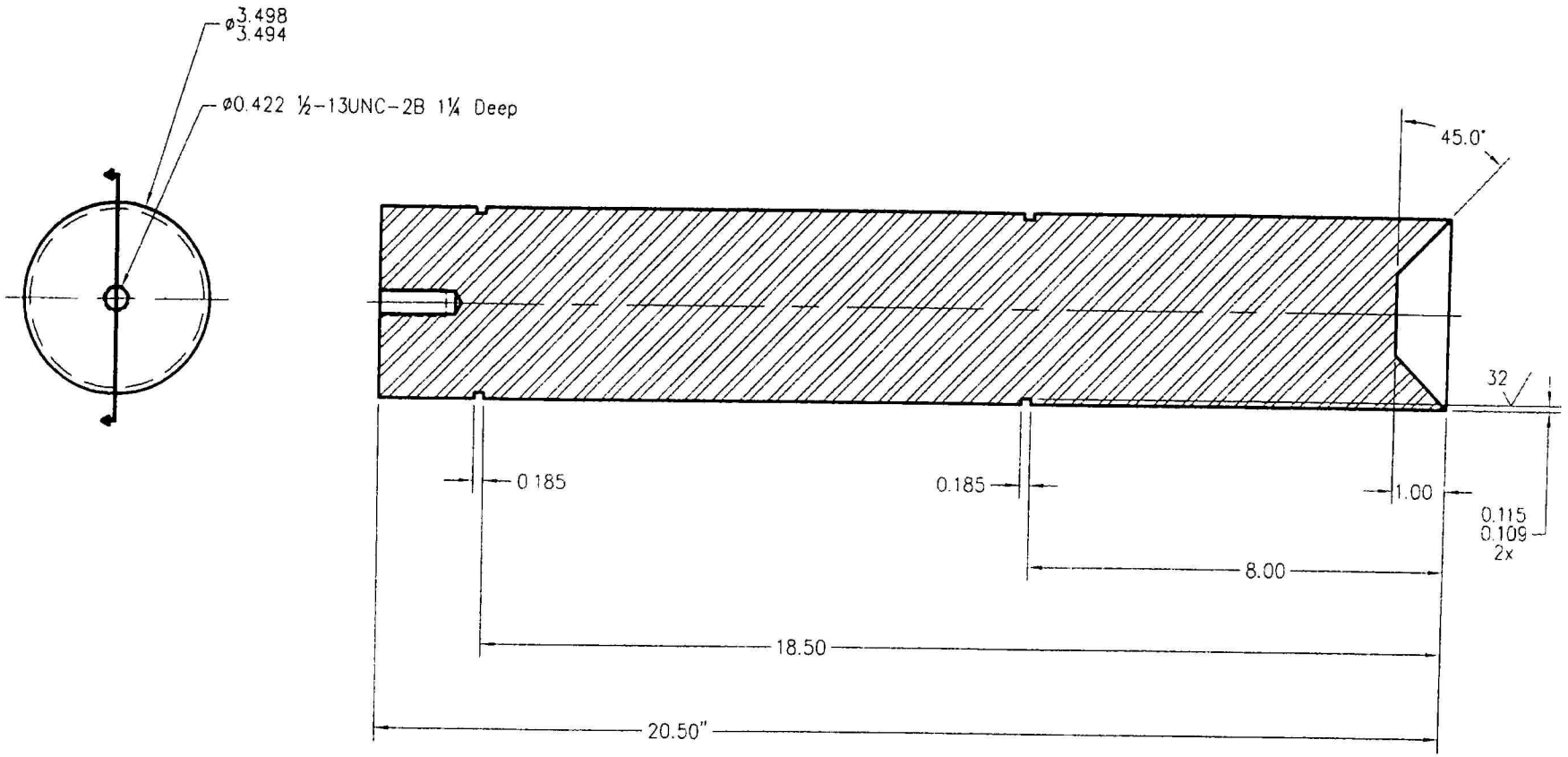
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN	DATE
M. Long	1/23/04
ENGINEER	DATE
APPROVED	DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy.

FINISH	MATERIAL	SCALE	SHEET		DRAWING NUMBER
16	Zelux-M&HDP	2:1	2 of 2	A	LGG-050



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH 63

DRAWN	M. Long	DATE 10/04/01
ENGINEER		DATE
APPROVED		DATE

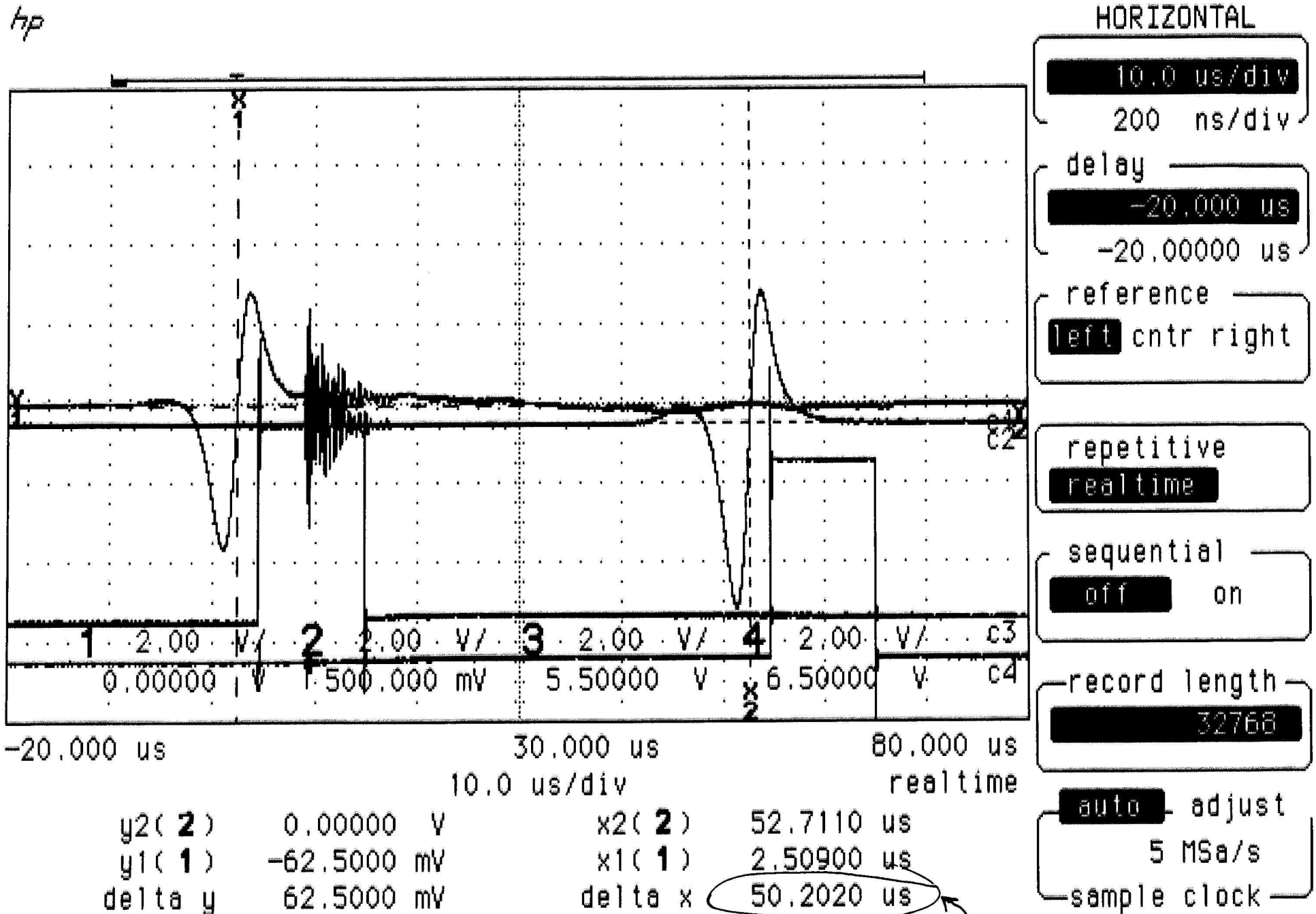
MATERIAL H.D. POLY

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

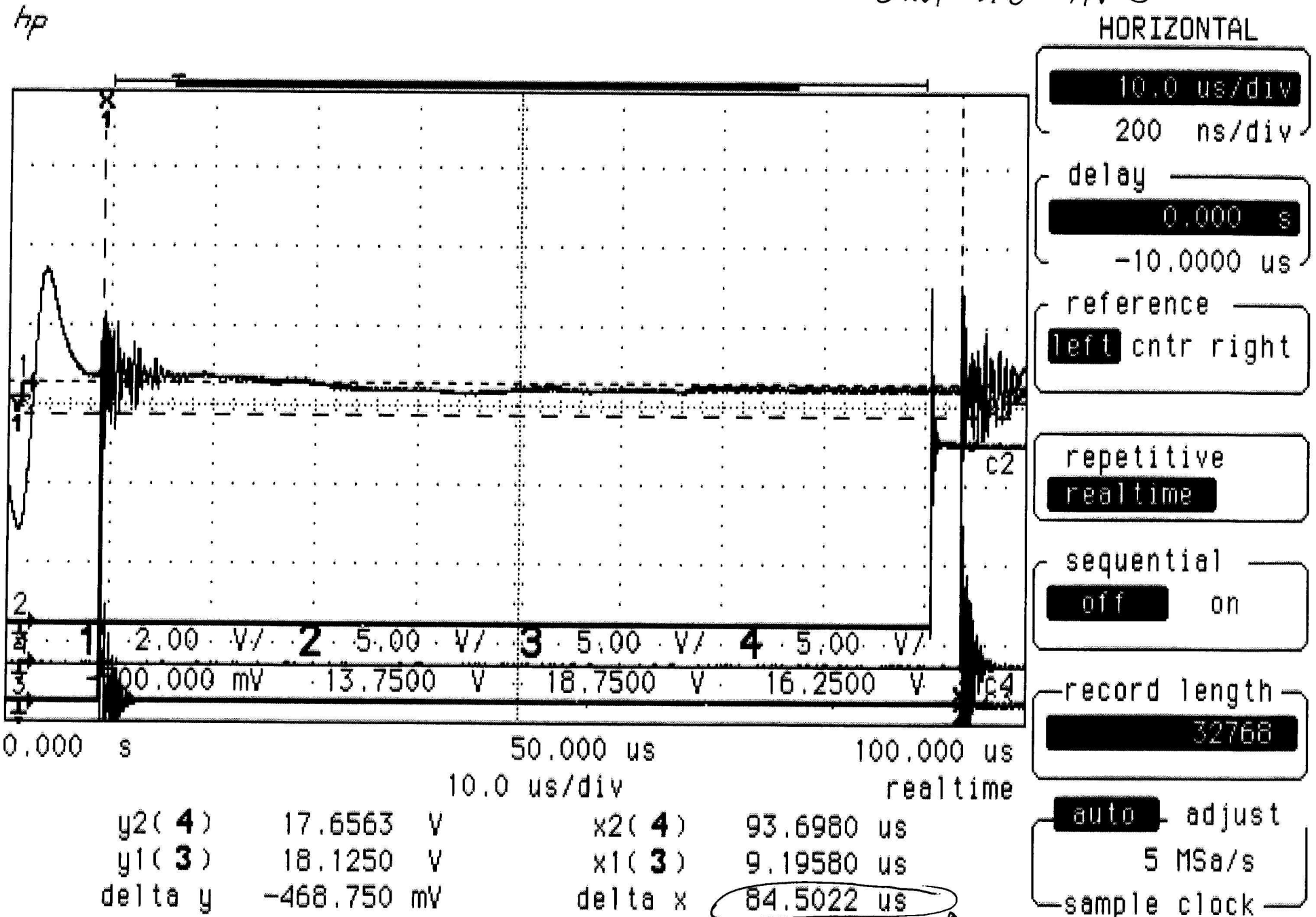
TITLE PISTON -1 Piece

SCALE 1:2 | SHEET 1 of 1 | B | DRAWING NUMBER LGG-029

Shot 418 HPS

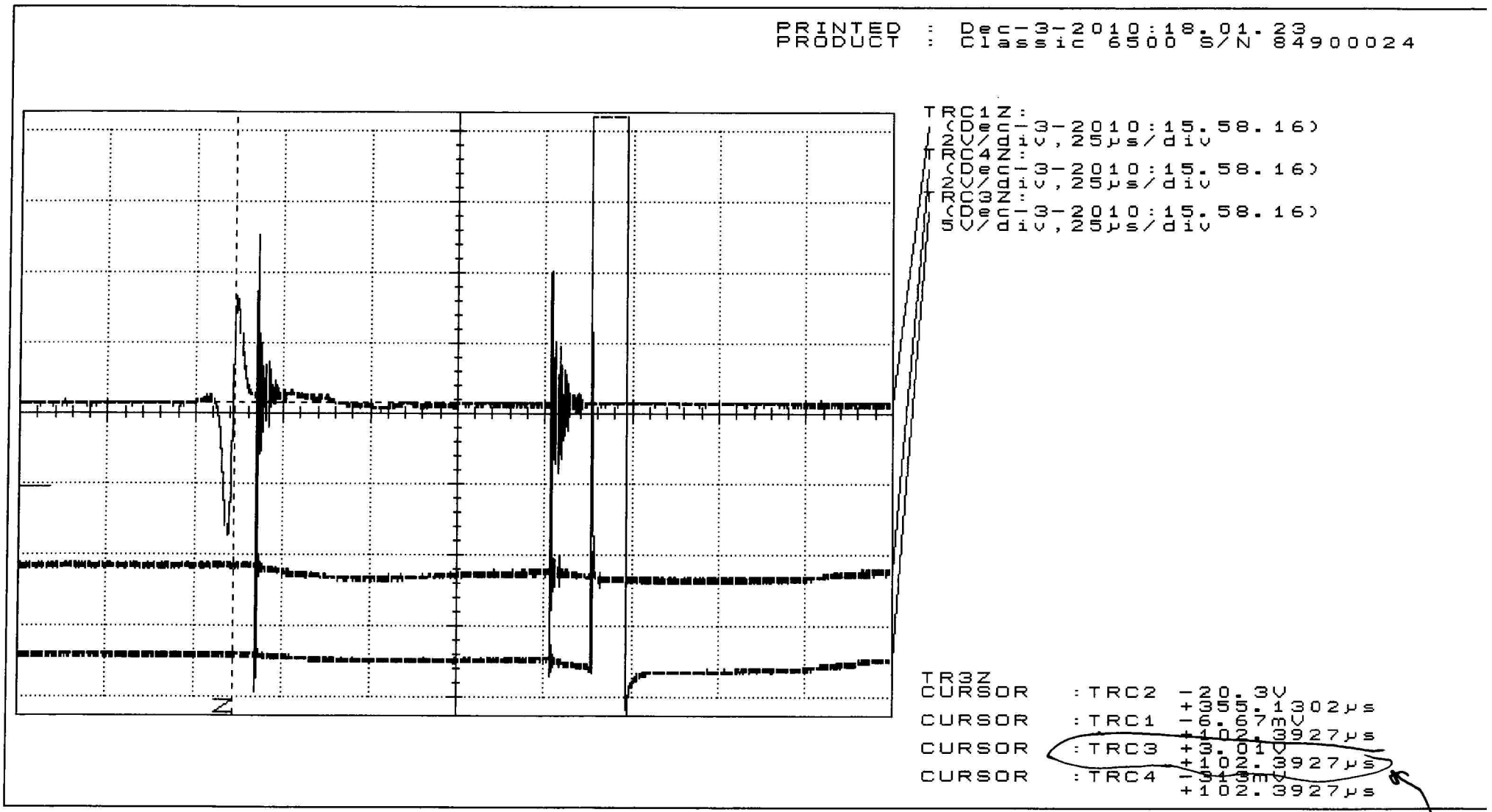

hp
HORIZONTAL
10.0 us/div
200 ns/div
delay
-20.000 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
5 MSa/s
sample clock
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/ c3
0.00000 V 1.500.000 mV 5.50000 V 6.50000 V c4
-20.000 us
30.000 us
80.000 us
10.0 us/div
realtime
y2(2) 0.00000 V
y1(1) -62.5000 mV
delta y 62.5000 mV
x2(2) 52.7110 us
x1(1) 2.50900 us
delta x 50.2020 us
1/delta x 19.9195 kHz
magnet 1 to 2 interval

Shot 418 HPG



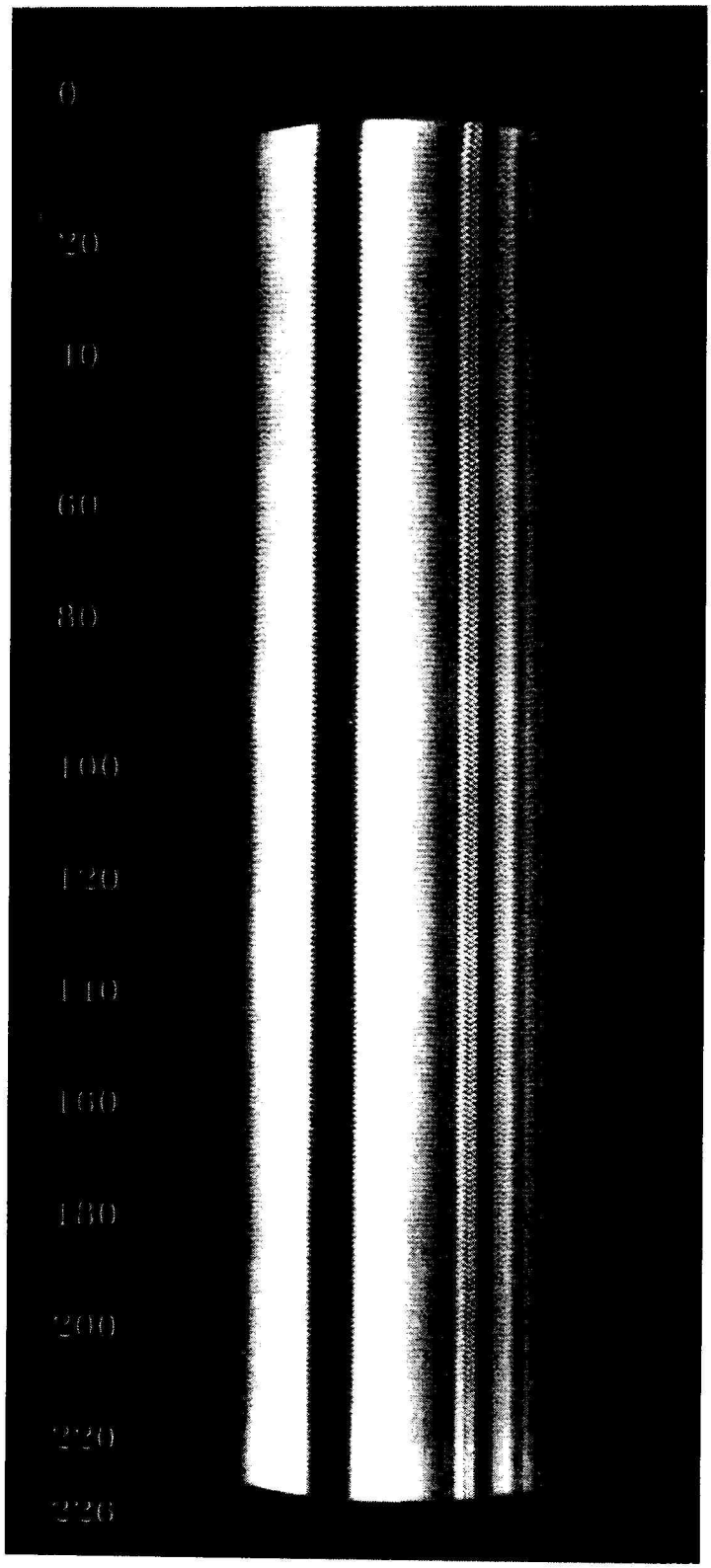
Xray 1 to 2 interval

Shot 418 GS7



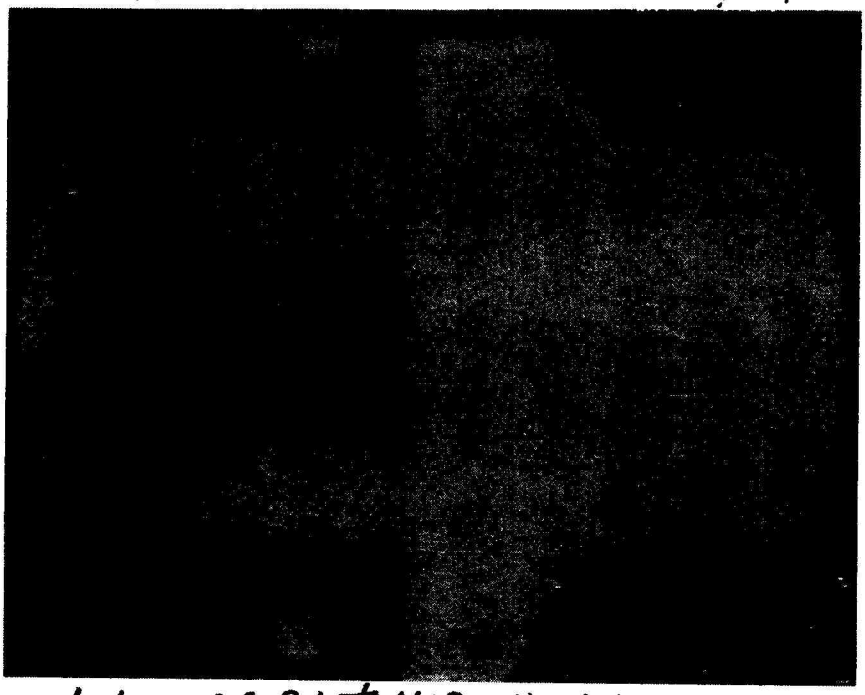
Velocity magnet 1 to camera trig signal

418 Cal.

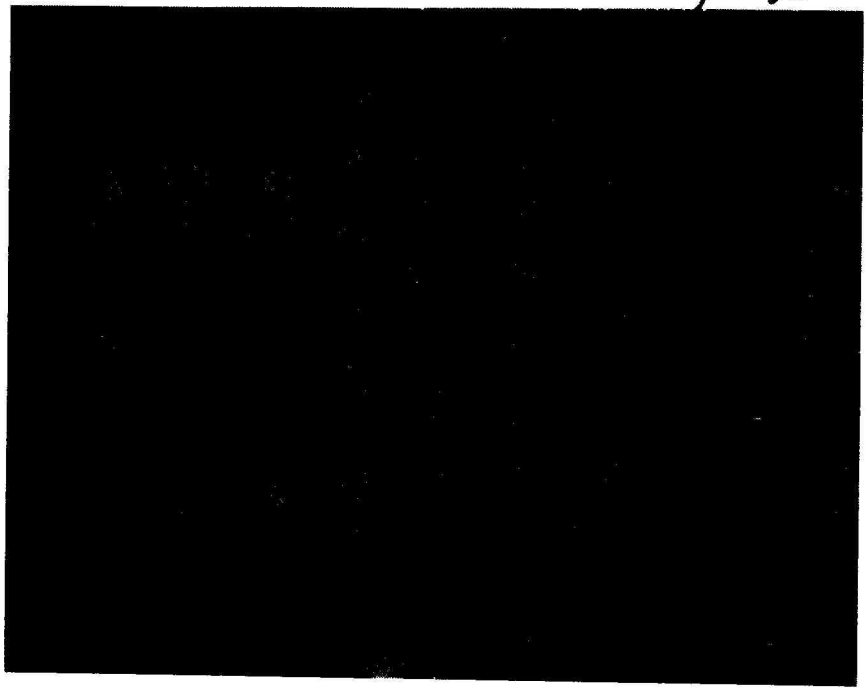


6.757ns/pk × 226 pks = 1527ns

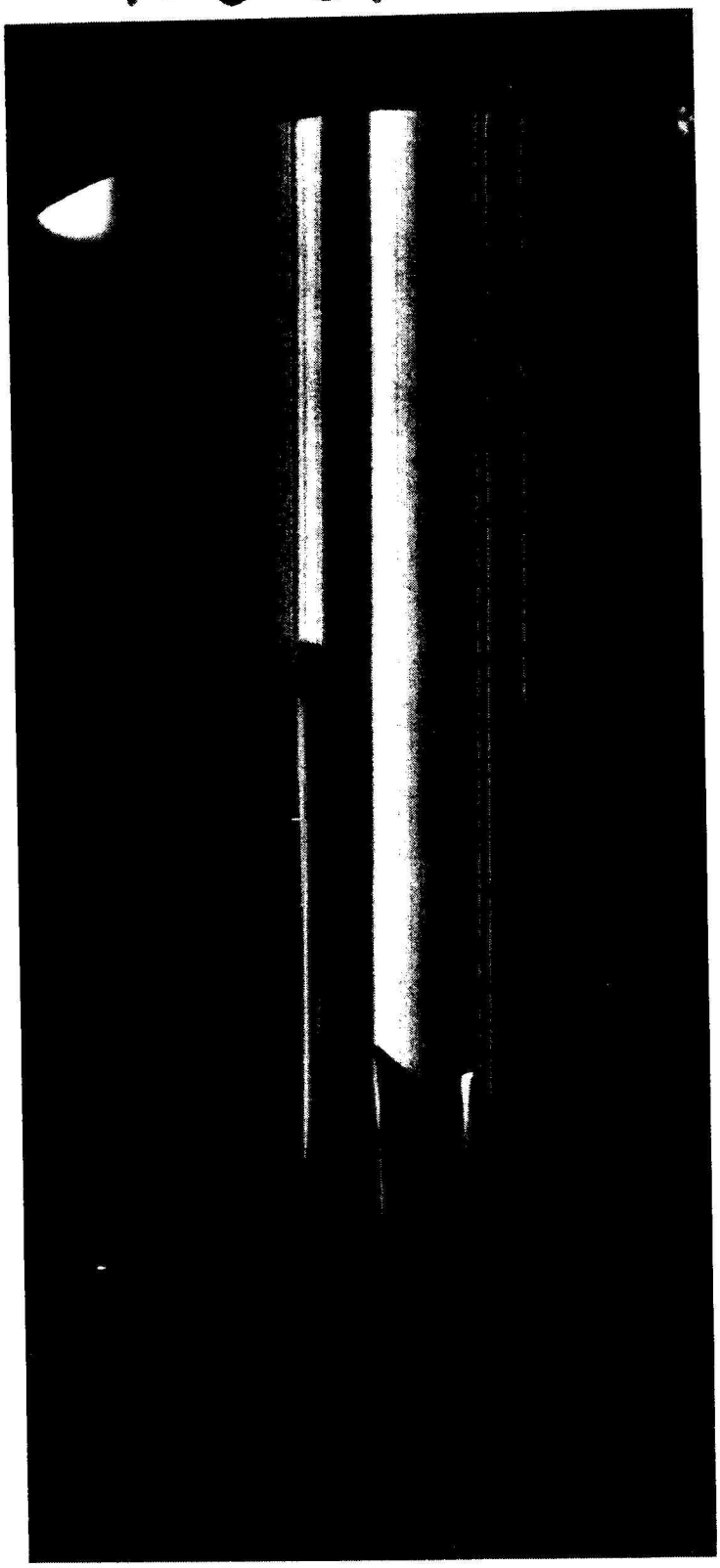
12/3/10 LGC Shot 418 Flash Xray #1



12/3/10 LGC Shot 418 Flash Xray #2



418 Shot



418 Shot

LIGHT GAS GUN DATA SHEET

Shot No. 419 Date 1/4/11

Target:

Sample Material Hedenbergite Crystallographic orientation _____

Source Location Univ. of Michigan Thickness:1 _____ in.

Type of Measurement EOS - preheated 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in.

Material _____

Projectile:

Weight 20.0817 gms. Length 0.906 in. Skirt Diameter 1.1101 in.

Flyer Plate Material Mo Leading Edge Dia. 1.1010 in.

Thickness 0.0609 in. Major Dia. 0.9818 in. Depth Inserted 2 in.

Minor Dia. 0.932 in. force (est.) 60-70 lbs

Barrel Dimensions:

Breech Diameter 1.1098 in. Muzzle Diameter 1.100 in. Taper 0.0098 in.

Ellipticity @ projectile depth insertion point 0.0806 in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth .108 in.

Diameter: Front 3.496 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 388 gms. Type IMR4350 Total Charge 400 gms.

Primer Charge 12 gms. Type IMR4350

Expected Velocity:

Projectile 3.5 km/sec Piston 0.45 km/sec

Notes: 1401°C @ shot time 7:20 min total heating time.

L.G.G.

Camera Streak Duration: 1527 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 0.84

Film Type: Streak Camera: Polaroid Type 57 Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 5.47 µsec Flash X-ray #2 106.82 µsec

Static Streak Photo 14.3 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0552 in. min.	0.0932 in. min.
0.0559 in. max.	0.094 in. max

Expected Burst Pressure 4k psi

Instrument Tank/Vacuum Pump Pressure: 60/80 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.95 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.454 km/sec

Piston Velocity from Gauge #1 to #3: 0.450 km/sec

Projectile Velocity from UDC: 3497 m/sec

Projectile Velocity from X-ray: _____ km/sec

3496 m/s

L.G.G.

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	671 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1355 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	58.3 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	99.858 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	112.001 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	12.147 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	99.913 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	58.22 µsec
UDC Velocity:			3497.18 M/sec

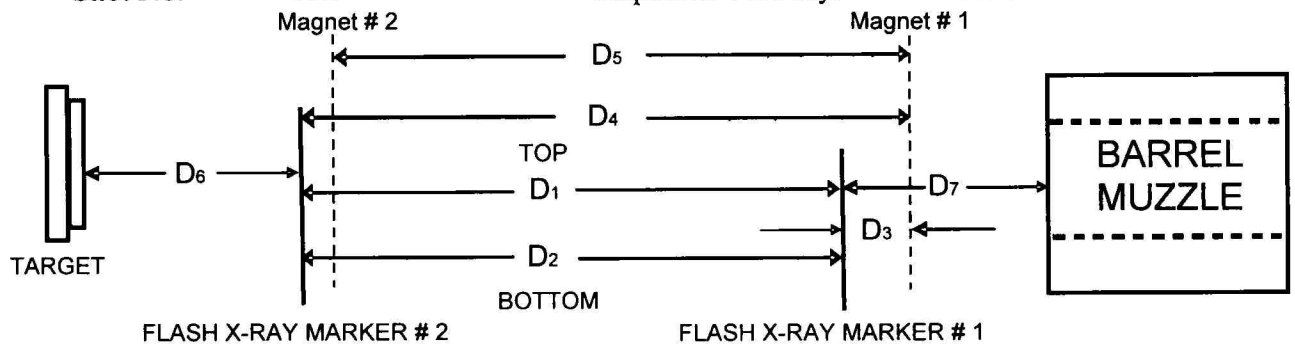
OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1 2.9712	Velocity magnet 2 61.1780	58.207 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start 4.9628	1.992 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop 63.1666	1.989 µsec
HP6, 1-2:	Velocity Magnet 1 2.9794	Xenon Lamp Trigger 108.345	105.366 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out 11.0402	X-ray 2 Pulser Monitor Out 110.950	99.910 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	119.712 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	119.992 µsec

raw magnet signal = 5.5V pk.
amplified magnet signal > 8 V pk (off scale)

TARGET MEASUREMENT

Shot No. **419** Expected Velocity: **3.50** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	39.5	99.0
Measure # 2, mm	30.00	383.15	203.66	39.5	99.0
Average, mm	30.00	383.15	203.61	39.5	99.0
Travel time, µsec	**8.57**	**109.47**	**58.17**	**11.29**	**28.29**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **100.92** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **100.88** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **5.47** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **106.82** µsec.

MAGNET DISTANCE

Shot No. **419** Expected Velocity: **3.50**

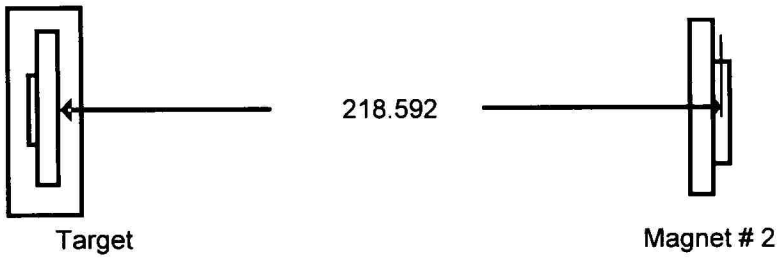
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = 58.173 µsec.

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.483 inch

Second measurement = 8.479 inch

Average measurement = 8.481 inch

Average measurement = 215.417 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 218.592 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = 62.455 µsec.

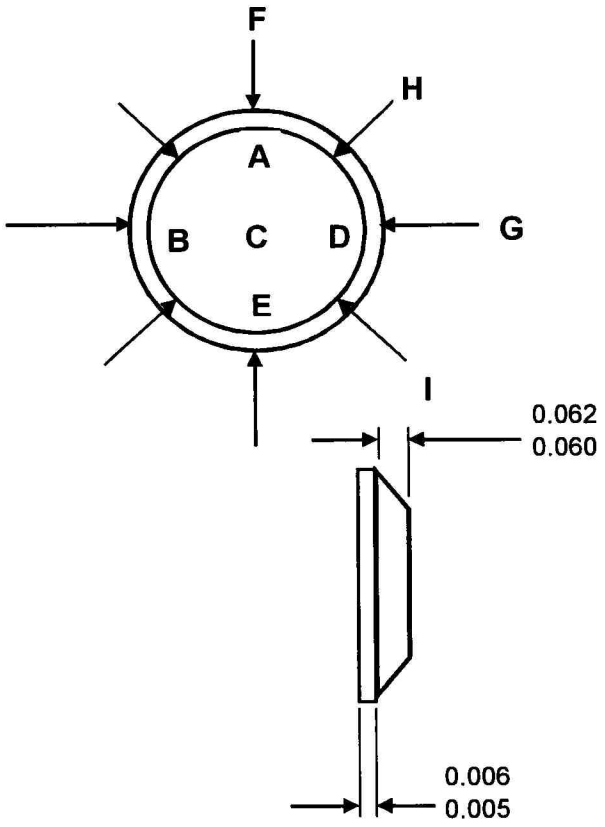
Fudged Distance between Magnet 2 to Target = ~~0 mm~~ 0.20766 m

SHOT No.

FLYER PLATE MATERIAL: Mo #1 3/3/2010

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06070	F	0.98200
A	0.06080	F	0.98250
B	0.06065	G	0.98200
B	0.06080	G	0.98100
C	0.06100	H	0.93200
C	0.06100	H	0.93200
D	0.06100	I	0.93200
D	0.06085	I	0.93200
E	0.06075		
E	0.06100		



Statistic for thickness

N	10	
MAX	0.06100	
MIN	0.06065	
Range	0.00035	
MEAN	0.060871429	inch
	1.546134286	mm
STDEV	0.00013496	

Statistic for Diameter (F-G)

N	4	
MAX	0.98250	
MIN	0.98100	
Range	0.00150	
MEAN	0.9818750	inch
	24.9396250	mm
STDEV	0.000629153	

Statistic for Diameter (H-I)

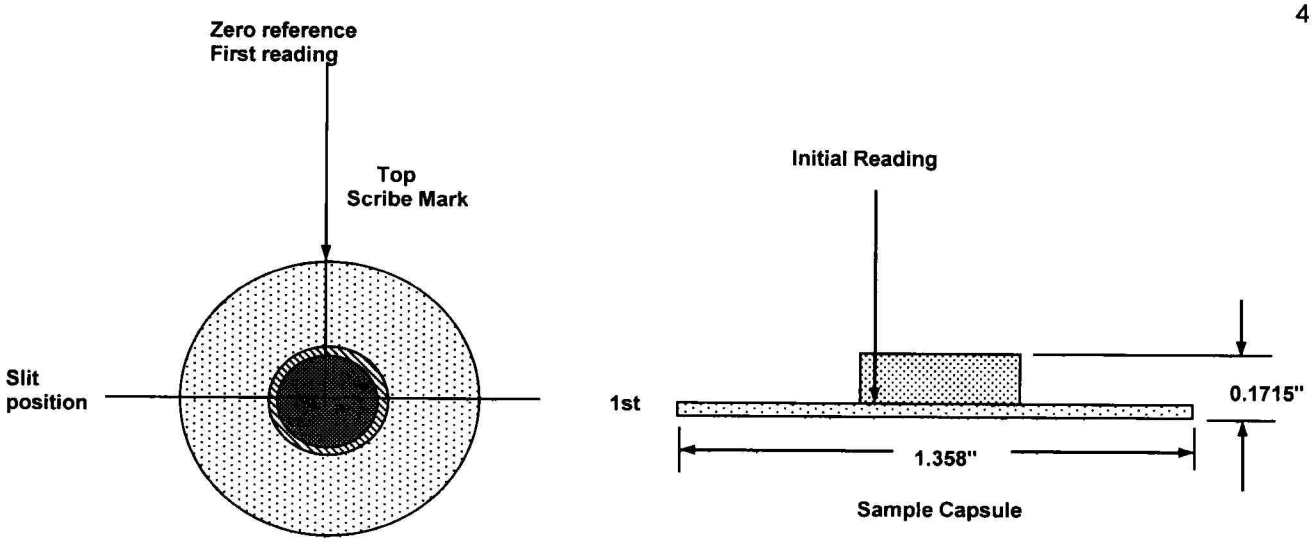
N	4	
MAX	0.93200	
MIN	0.93200	
Range	0.00000	
MEAN	0.932	inch
	23.6728	mm
STDEV	0	

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	20.7	1.8843	7.1747	8.45025	0.8650	10.1948
2	20.7	1.88436	7.17473	8.45020	0.8650	10.1925
3	20.7	1.88439	7.17473	8.4503	0.8650	10.1936
	THICKNESS		0.060871429	±	in	
	FLATNESS:		0.00035	in.		
	VOLUME:		0.7553	2.29E-03	cm^3	
	CRYSTAL DENSITY:		10.1936	1.15E-03	$grams/cm^3$	
	BULK DENSITY:		9.4992	2.29E-03	$grams/cm^3$	
	DENSITIES CHECKED BY: _		Russ	3/3/2010		
	MEASUREMENT CHECKED		Russ	3/3/2010		

SAMPLE CAPSULE: **12** 6/7/2010
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

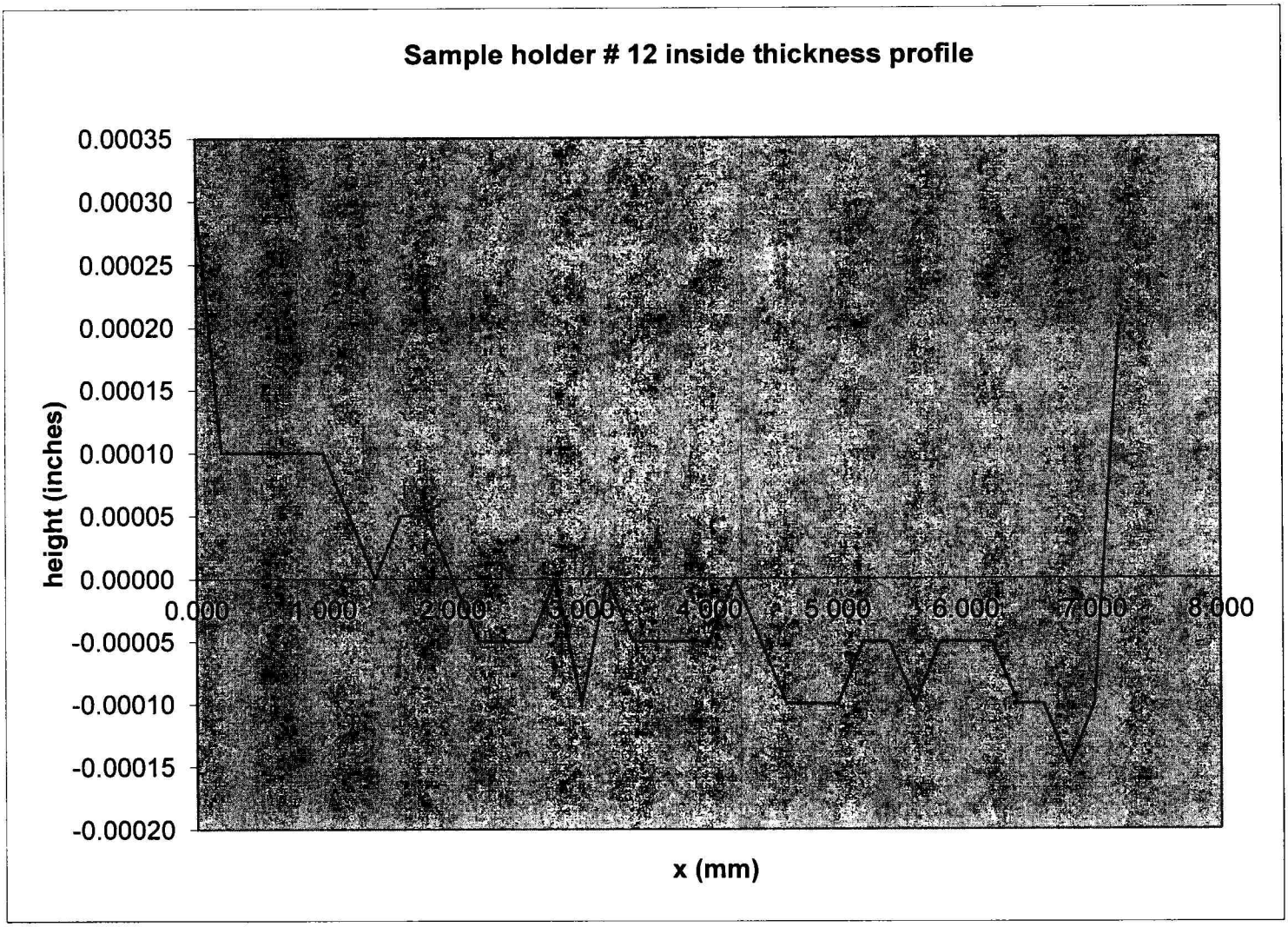
4.683
4.623



1.338582677

Average thickness reading = 0.00010

Note: The thickness of the reference zero point from the base is = 0.04195 Inches
1.06553 mm


Sample holder # 12 inside thickness profile
0.00035
0.00030
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
-0.00005
-0.00010
-0.00015
-0.00020
height (inches)
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
x (mm)

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00030	3.474	south
2	0.200	0.00010	3.27400	
3	0.400	0.00010	3.07400	
4	0.600	0.00010	2.87400	
5	0.800	0.00010	2.67400	
6	1.000	0.00010	2.47400	
7	1.200	0.00005	2.27400	
8	1.400	0.00000	2.07400	
9	1.600	0.00005	1.87400	
10	1.800	0.00005	1.67400	
11	2.000	0.00000	1.47400	
12	2.200	-0.00005	1.27400	
13	2.400	-0.00005	1.07400	
14	2.600	-0.00005	0.87400	
15	2.800	0.00000	0.67400	
16	3.000	-0.00010	0.47400	
17	3.200	0.00000	0.27400	
18	3.400	-0.00005	0.07400	
19	3.600	-0.00005	-0.12600	
20	3.800	-0.00005	-0.32600	
21	4.000	-0.00005	-0.52600	
22	4.200	0.00000	-0.72600	
23	4.400	-0.00005	-0.92600	
24	4.600	-0.00010	-1.12600	
25	4.800	-0.00010	-1.32600	
26	5.000	-0.00010	-1.52600	
27	5.200	-0.00005	-1.72600	
28	5.400	-0.00005	-1.92600	
29	5.600	-0.00010	-2.12600	
30	5.800	-0.00005	-2.32600	
31	6.000	-0.00005	-2.52600	
32	6.200	-0.00005	-2.72600	
33	6.400	-0.00010	-2.92600	
34	6.600	-0.00010	-3.12600	
35	6.800	-0.00015	-3.32600	
36	7.000	-0.00010	-3.52600	
37	7.200	0.00020	-3.72600	north

Carbon coating
11/23/2010
Claire Waller

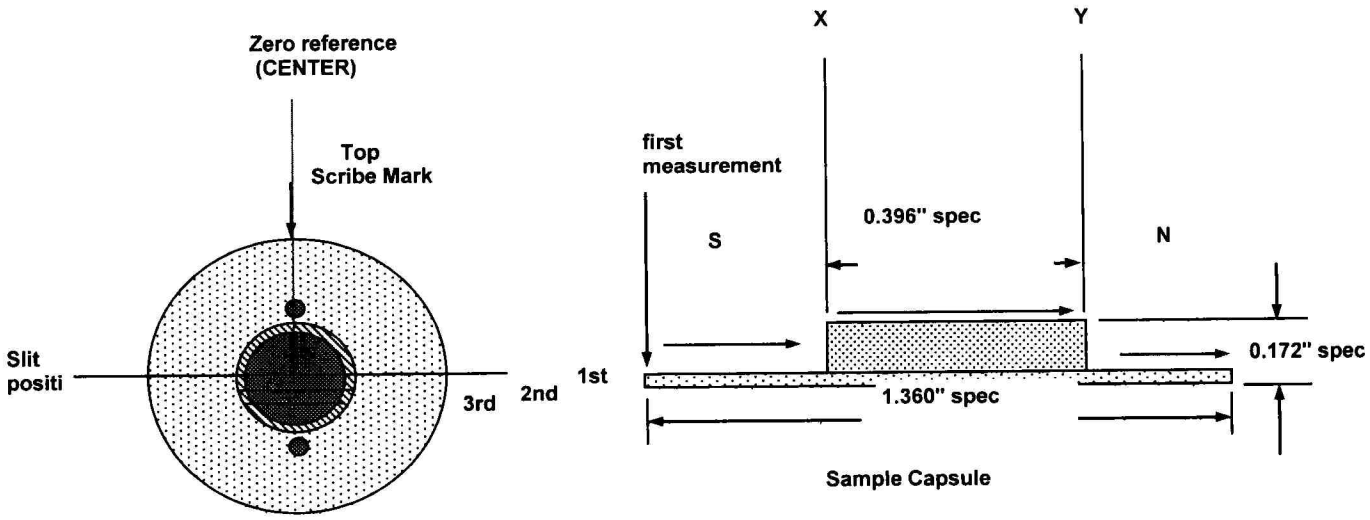
		No. of coatings						
Sample Holder		**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Hd #11 & 12	sample-side	18.5	15.4	13.8	11.6	13.1	12.6	85
	recoat after some peeling	15.8	11					
	projectile (driver) side	11.9	15.8	16.2	17.3	12.6	11.6	85.4

SHOT No. 419
SAMPLE CAPSULE: 12
SAMPLE MATERIAL: Hedenbergite

tip used: .7mm long/ flat tip
note: the platform on which the measurement was taken deviates from flat by +0.013 max.
direction of measurement

4.849
1.792

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = 0.00013

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = 0.00025

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = 0.00033

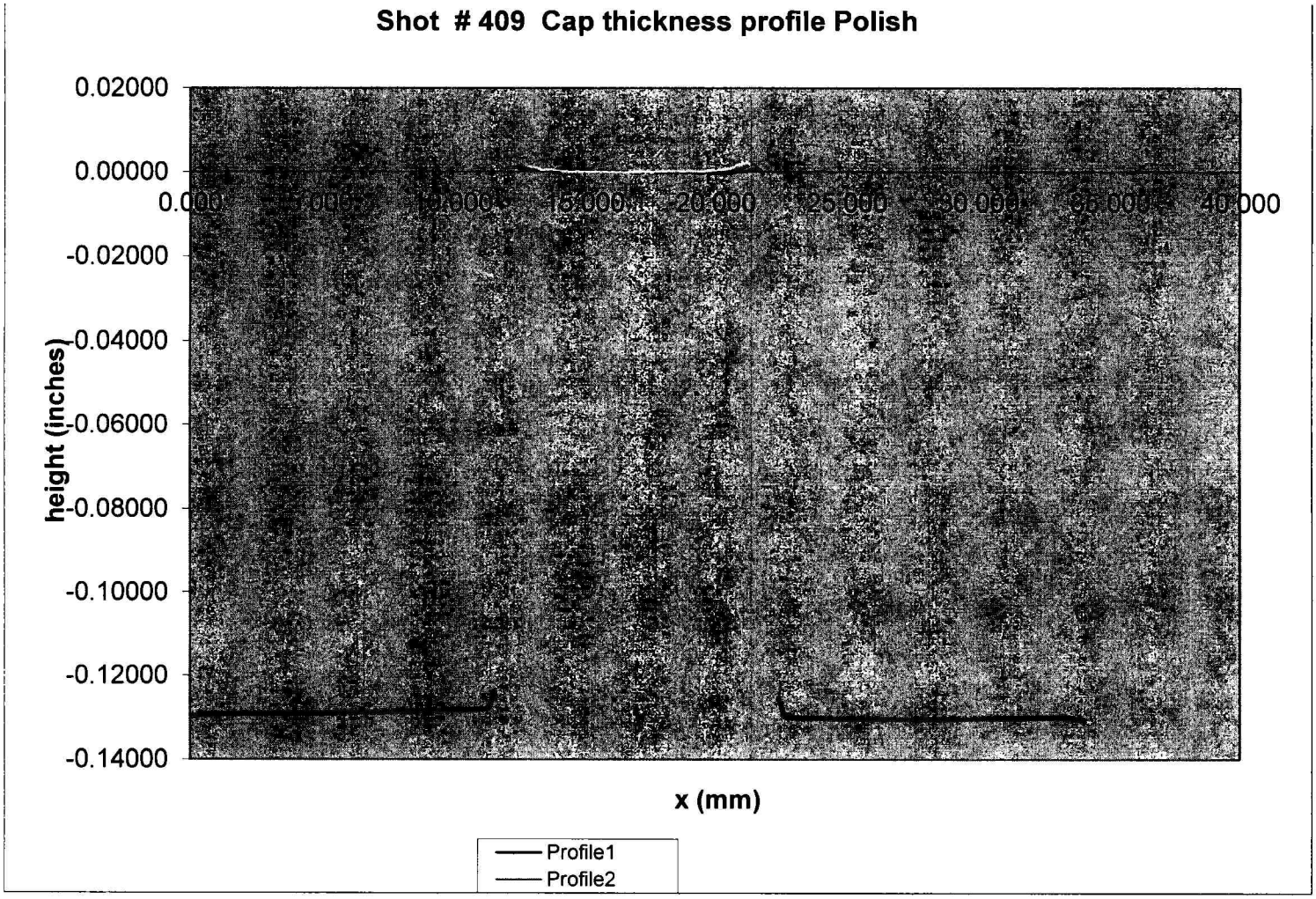
Note: Measurement from reference zero point from the base is = 0.1752 Inches
4.4501 mm

Average thickness of the driver Plate = 0.0457 Inches
1.1613 mm

Thickness of the Carbon Deposited on the coil side is = (85+36.8) recoat due to peeling 121.8 **nm**

Thickness of the Carbon Deposited on the Projectile side is = 85.4 **nm**

Distance from the top of the cap to the measured (avg) driver plate **0.13** Inches
3.29 mm


Shot # 409 Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
height (inches)
0.000
15.000
20.000
25.000
40.000
x (mm)
Profile1
Profile2

1. **First Run Horizontal (X) thru the center with 0.100 MM increment**
2. **Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM increment**
3. **Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment**

Number of Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right	Number of Reading	Reading Distance mm
1	0.000	17.000	-0.1299	225	22.400	-5.400	-0.1257	118	11.700
2	0.100	16.900	-0.1297	226	22.500	-5.500	-0.1271	119	11.800
3	0.200	16.800	-0.1296	227	22.600	-5.600	-0.1294	120	11.900
4	0.300	16.700	-0.1296	228	22.700	-5.700	-0.1300	121	12.000
5	0.400	16.600	-0.1295	229	22.800	-5.800	-0.1301	122	12.100
6	0.500	16.500	-0.1294	230	22.900	-5.900	-0.1301	123	12.200
7	0.600	16.400	-0.1294	231	23.000	-6.000	-0.1301	124	12.300
8	0.700	16.300	-0.1293	232	23.100	-6.100	-0.1301	125	12.400
9	0.800	16.200	-0.1293	233	23.200	-6.200	-0.1301	126	12.500
10	0.900	16.100	-0.1293	234	23.300	-6.300	-0.1301	127	12.600
11	1.000	16.000	-0.1293	235	23.400	-6.400	-0.1302	128	12.700
12	1.100	15.900	-0.1293	236	23.500	-6.500	-0.1302	129	12.800
13	1.200	15.800	-0.1293	237	23.600	-6.600	-0.1302	130	12.900
14	1.300	15.700	-0.1292	238	23.700	-6.700	-0.1302	131	13.000
15	1.400	15.600	-0.1292	239	23.800	-6.800	-0.1302	132	13.100
16	1.500	15.500	-0.1292	240	23.900	-6.900	-0.1302	133	13.200
17	1.600	15.400	-0.1292	241	24.000	-7.000	-0.1302	134	13.300
18	1.700	15.300	-0.1292	242	24.100	-7.100	-0.1302	135	13.400
19	1.800	15.200	-0.1292	243	24.200	-7.200	-0.1302	136	13.500
20	1.900	15.100	-0.1292	244	24.300	-7.300	-0.1303	137	13.600
21	2.000	15.000	-0.1292	245	24.400	-7.400	-0.1303	138	13.700
22	2.100	14.900	-0.1291	246	24.500	-7.500	-0.1303	139	13.800
23	2.200	14.800	-0.1291	247	24.600	-7.600	-0.1303	140	13.900
24	2.300	14.700	-0.1291	248	24.700	-7.700	-0.1303	141	14.000
25	2.400	14.600	-0.1292	249	24.800	-7.800	-0.1303	142	14.100
26	2.500	14.500	-0.1291	250	24.900	-7.900	-0.1303	143	14.200
27	2.600	14.400	-0.1291	251	25.000	-8.000	-0.1303	144	14.300
28	2.700	14.300	-0.1291	252	25.100	-8.100	-0.1303	145	14.400
29	2.800	14.200	-0.1291	253	25.200	-8.200	-0.1303	146	14.500
30	2.900	14.100	-0.1291	254	25.300	-8.300	-0.1304	147	14.600
31	3.000	14.000	-0.1291	255	25.400	-8.400	-0.1303	148	14.700
32	3.100	13.900	-0.1291	256	25.500	-8.500	-0.1303	149	14.800
33	3.200	13.800	-0.1291	257	25.600	-8.600	-0.1304	150	14.900
34	3.300	13.700	-0.1291	258	25.700	-8.700	-0.1304	151	15.000
35	3.400	13.600	-0.1291	259	25.800	-8.800	-0.1303	152	15.100
36	3.500	13.500	-0.1291	260	25.900	-8.900	-0.1303	153	15.200
37	3.600	13.400	-0.1290	261	26.000	-9.000	-0.1304	154	15.300
38	3.700	13.300	-0.1290	262	26.100	-9.100	-0.1303	155	15.400
39	3.800	13.200	-0.1290	263	26.200	-9.200	-0.1303	156	15.500
40	3.900	13.100	-0.1290	264	26.300	-9.300	-0.1304	157	15.600
41	4.000	13.000	-0.1290	265	26.400	-9.400	-0.1304	158	15.700
42	4.100	12.900	-0.1290	266	26.500	-9.500	-0.1304	159	15.800
43	4.200	12.800	-0.1290	267	26.600	-9.600	-0.1304	160	15.900
44	4.300	12.700	-0.1290	268	26.700	-9.700	-0.1304	161	16.000
45	4.400	12.600	-0.1290	269	26.800	-9.800	-0.1304	162	16.100
46	4.500	12.500	-0.1290	270	26.900	-9.900	-0.1304	163	16.200
47	4.600	12.400	-0.1290	271	27.000	-10.000	-0.1304	164	16.300
48	4.700	12.300	-0.1290	272	27.100	-10.100	-0.1304	165	16.400
49	4.800	12.200	-0.1290	273	27.200	-10.200	-0.1304	166	16.500
50	4.900	12.100	-0.1290	274	27.300	-10.300	-0.1304	167	16.600
51	5.000	12.000	-0.1290	275	27.400	-10.400	-0.1304	168	16.700
52	5.100	11.900	-0.1290	276	27.500	-10.500	-0.1304	169	16.800

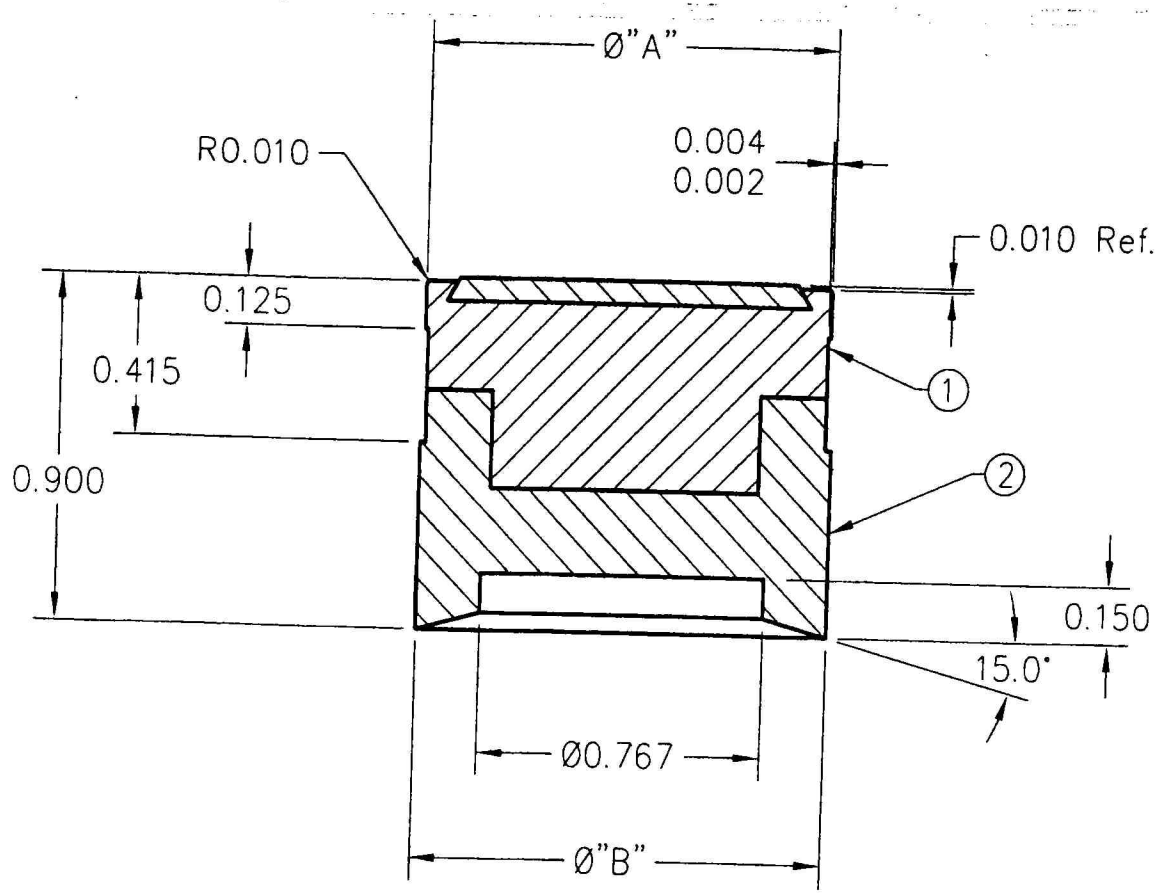
53	5.200	11.800	-0.1289	277	27.600	-10.600	-0.1303	170	16.900
54	5.300	11.700	-0.1290	278	27.700	-10.700	-0.1304	171	17.000
55	5.400	11.600	-0.1290	279	27.800	-10.800	-0.1304	172	17.100
56	5.500	11.500	-0.1290	280	27.900	-10.900	-0.1304	173	17.200
57	5.600	11.400	-0.1289	281	28.000	-11.000	-0.1304	174	17.300
58	5.700	11.300	-0.1289	282	28.100	-11.100	-0.1304	175	17.400
59	5.800	11.200	-0.1289	283	28.200	-11.200	-0.1304	176	17.500
60	5.900	11.100	-0.1289	284	28.300	-11.300	-0.1304	177	17.600
61	6.000	11.000	-0.1289	285	28.400	-11.400	-0.1303	178	17.700
62	6.100	10.900	-0.1289	286	28.500	-11.500	-0.1304	179	17.800
63	6.200	10.800	-0.1289	287	28.600	-11.600	-0.1304	180	17.900
64	6.300	10.700	-0.1289	288	28.700	-11.700	-0.1303	181	18.000
65	6.400	10.600	-0.1289	289	28.800	-11.800	-0.1303	182	18.100
66	6.500	10.500	-0.1289	290	28.900	-11.900	-0.1304	183	18.200
67	6.600	10.400	-0.1288	291	29.000	-12.000	-0.1303	184	18.300
68	6.700	10.300	-0.1288	292	29.100	-12.100	-0.1303	185	18.400
69	6.800	10.200	-0.1288	293	29.200	-12.200	-0.1303	186	18.500
70	6.900	10.100	-0.1288	294	29.300	-12.300	-0.1303	187	18.600
71	7.000	10.000	-0.1288	295	29.400	-12.400	-0.1303	188	18.700
72	7.100	9.900	-0.1288	296	29.500	-12.500	-0.1303	189	18.800
73	7.200	9.800	-0.1288	297	29.600	-12.600	-0.1303	190	18.900
74	7.300	9.700	-0.1288	298	29.700	-12.700	-0.1303	191	19.000
75	7.400	9.600	-0.1287	299	29.800	-12.800	-0.1303	192	19.100
76	7.500	9.500	-0.1287	300	29.900	-12.900	-0.1303	193	19.200
77	7.600	9.400	-0.1287	301	30.000	-13.000	-0.1303	194	19.300
78	7.700	9.300	-0.1287	302	30.100	-13.100	-0.1303	195	19.400
79	7.800	9.200	-0.1287	303	30.200	-13.200	-0.1303	196	19.500
80	7.900	9.100	-0.1287	304	30.300	-13.300	-0.1302	197	19.600
81	8.000	9.000	-0.1286	305	30.400	-13.400	-0.1303	198	19.700
82	8.100	8.900	-0.1286	306	30.500	-13.500	-0.1303	199	19.800
83	8.200	8.800	-0.1286	307	30.600	-13.600	-0.1303	200	19.900
84	8.300	8.700	-0.1286	308	30.700	-13.700	-0.1302	201	20.000
85	8.400	8.600	-0.1286	309	30.800	-13.800	-0.1302	202	20.100
86	8.500	8.500	-0.1285	310	30.900	-13.900	-0.1302	203	20.200
87	8.600	8.400	-0.1285	311	31.000	-14.000	-0.1302	204	20.300
88	8.700	8.300	-0.1285	312	31.100	-14.100	-0.1302	205	20.400
89	8.800	8.200	-0.1285	313	31.200	-14.200	-0.1302	206	20.500
90	8.900	8.100	-0.1285	314	31.300	-14.300	-0.1302	207	20.600
91	9.000	8.000	-0.1284	315	31.400	-14.400	-0.1302	208	20.700
92	9.100	7.900	-0.1284	316	31.500	-14.500	-0.1302	209	20.800
93	9.200	7.800	-0.1284	317	31.600	-14.600	-0.1301	210	20.900
94	9.300	7.700	-0.1284	318	31.700	-14.700	-0.1301	211	21.000
95	9.400	7.600	-0.1284	319	31.800	-14.800	-0.1302	212	21.100
96	9.500	7.500	-0.1284	320	31.900	-14.900	-0.1302	213	21.200
97	9.600	7.400	-0.1284	321	32.000	-15.000	-0.1301	214	21.300
98	9.700	7.300	-0.1283	322	32.100	-15.100	-0.1302	215	21.400
99	9.800	7.200	-0.1283	323	32.200	-15.200	-0.1301	216	21.500
100	9.900	7.100	-0.1283	324	32.300	-15.300	-0.1301	217	21.600
101	10.000	7.000	-0.1283	325	32.400	-15.400	-0.1301	218	21.700
102	10.100	6.900	-0.1283	326	32.500	-15.500	-0.1301	219	21.800
103	10.200	6.800	-0.1283	327	32.600	-15.600	-0.1301	220	21.900
104	10.300	6.700	-0.1283	328	32.700	-15.700	-0.1301	221	22.000
105	10.400	6.600	-0.1282	329	32.800	-15.800	-0.1301	222	22.100
106	10.500	6.500	-0.1282	330	32.900	-15.900	-0.1301	223	22.200
107	10.600	6.400	-0.1282	331	33.000	-16.000	-0.1301	224	22.300
108	10.700	6.300	-0.1282	332	33.100	-16.100	-0.1301		
109	10.800	6.200	-0.1282	333	33.200	-16.200	-0.1301		
110	10.900	6.100	-0.1281	334	33.300	-16.300	-0.1301		
111	11.000	6.000	-0.1281	335	33.400	-16.400	-0.1301		
112	11.100	5.900	-0.1281	336	33.500	-16.500	-0.1302		

113	11.200	5.800	-0.1280	337	33.600	-16.600	-0.1303
114	11.300	5.700	-0.1279	338	33.700	-16.700	-0.1303
115	11.400	5.600	-0.1275	339	33.800	-16.800	-0.1305
116	11.500	5.500	-0.1260	340	33.900	-16.900	-0.1306
117	11.600	5.400	-0.1239	341	34.000	-17.000	-0.1307

0.002627

abs dist.	1st Run Reading	2nd Run Reading	3 rd Run Reading
mm	Inches	Inches	Inches
5.300			
5.200			
5.100			
5.000			
4.900			
4.800			
4.700	0.00117		
4.600	0.00111		
4.500	0.00094	0.00159	
4.400	0.00068	0.00128	
4.300	0.00057	0.00107	
4.200	0.00061	0.00081	
4.100	0.00054	0.00064	0.00134
4.000	0.00048	0.00048	0.00113
3.900	0.00052	0.00057	0.00102
3.800	0.00046	0.00056	0.00081
3.700	0.00044	0.00044	0.00059
3.600	0.00043	0.00038	0.00033
3.500	0.00042	0.00037	0.00047
3.400	0.00040	0.00035	0.00050
3.300	0.00039	0.00034	0.00049
3.200	0.00038	0.00033	0.00043
3.100	0.00037	0.00032	0.00037
3.000	0.00040	0.00035	0.00035
2.900	0.00034	0.00029	0.00019
2.800	0.00033	0.00028	0.00023
2.700	0.00031	0.00026	0.00016
2.600	0.00030	0.00020	0.00010
2.500	0.00029	0.00019	0.00009
2.400	0.00027	0.00017	0.00007
2.300	0.00031	0.00026	0.00016
2.200	0.00025	0.00020	0.00010
2.100	0.00024	0.00019	0.00009
2.000	0.00022	0.00017	0.00007
1.900	0.00021	0.00016	0.00006
1.800	0.00020	0.00015	0.00005
1.700	0.00018	0.00013	0.00003
1.600	0.00017	0.00012	0.00007
1.500	0.00021	0.00016	0.00006
1.400	0.00014	0.00009	0.00004
1.300	0.00018	0.00013	0.00003
1.200	0.00017	0.00012	0.00007
1.100	0.00010	0.00005	-0.00005
1.000	0.00014	0.00009	-0.00001
0.900	0.00012	0.00007	0.00002
0.800	0.00006	0.00001	-0.00004
0.700	0.00010	0.00005	0.00000
0.600	0.00003	-0.00002	-0.00007
0.500	0.00002	-0.00003	-0.00008
0.400	0.00006	0.00001	-0.00004
0.300	0.00004	-0.00001	-0.00001
0.200	0.00003	-0.00002	-0.00002

0.100	0.00001	0.00001	0.00001
0.000	0.00000	0.00000	0.00000
-0.100	-0.00001	-0.00001	-0.00001
-0.200	-0.00003	-0.00003	0.00002
-0.300	-0.00004	-0.00004	-0.00004
-0.400	-0.00006	-0.00006	-0.00001
-0.500	-0.00007	-0.00007	-0.00002
-0.600	-0.00003	-0.00003	-0.00003
-0.700	-0.00005	0.00000	0.00000
-0.800	-0.00006	-0.00001	0.00004
-0.900	-0.00008	-0.00003	0.00007
-1.000	-0.00009	-0.00004	0.00001
-1.100	-0.00011	-0.00006	-0.00001
-1.200	-0.00007	0.00003	0.00008
-1.300	-0.00009	-0.00004	0.00006
-1.400	-0.00010	0.00000	0.00010
-1.500	-0.00011	-0.00001	0.00009
-1.600	-0.00013	-0.00003	0.00007
-1.700	-0.00014	-0.00004	0.00006
-1.800	-0.00016	-0.00006	0.00004
-1.900	-0.00012	0.00003	0.00013
-2.000	-0.00014	0.00001	0.00011
-2.100	-0.00015	0.00000	0.00010
-2.200	-0.00017	-0.00002	0.00008
-2.300	-0.00018	-0.00003	0.00007
-2.400	-0.00020	-0.00005	0.00005
-2.500	-0.00021	-0.00006	0.00004
-2.600	-0.00018	-0.00003	0.00007
-2.700	-0.00019	-0.00004	0.00021
-2.800	-0.00021	-0.00006	0.00019
-2.900	-0.00022	-0.00002	0.00033
-3.000	-0.00024	-0.00009	0.00036
-3.100	-0.00025	-0.00010	0.00045
-3.200	-0.00027	-0.00012	0.00048
-3.300	-0.00028	-0.00008	0.00057
-3.400	-0.00035	0.00010	0.00070
-3.500	-0.00036	0.00014	0.00069
-3.600	-0.00028	0.00022	0.00102
-3.700	-0.00019	0.00031	0.00121
-3.800	-0.00001	0.00064	0.00169
-3.900	0.00003	0.00068	0.00178
-4.000	-0.00004	0.00076	0.00186
-4.100	-0.00001	0.00094	0.00204
-4.200	0.00023	0.00138	0.00253
-4.300	0.00046	0.00171	0.00171
-4.400	0.00065	0.00180	
-4.500	0.00063	0.00173	
-4.600	0.00062	0.00062	
-4.700	0.00060		
-4.800	-0.00076		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			



as built 0.0609 Mo#1 10/19/10

SHOT# 419

A	1.1010"	+.0000 -.0005
B	1.1100"	+.0005 -.0000

1.1010

1.1101

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-128	1
1	Sabot & Flyer Plate	LGG-157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long DATE 11/29/10
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE
Projectile Assy.
for 28mm launch tube

FINISH 16

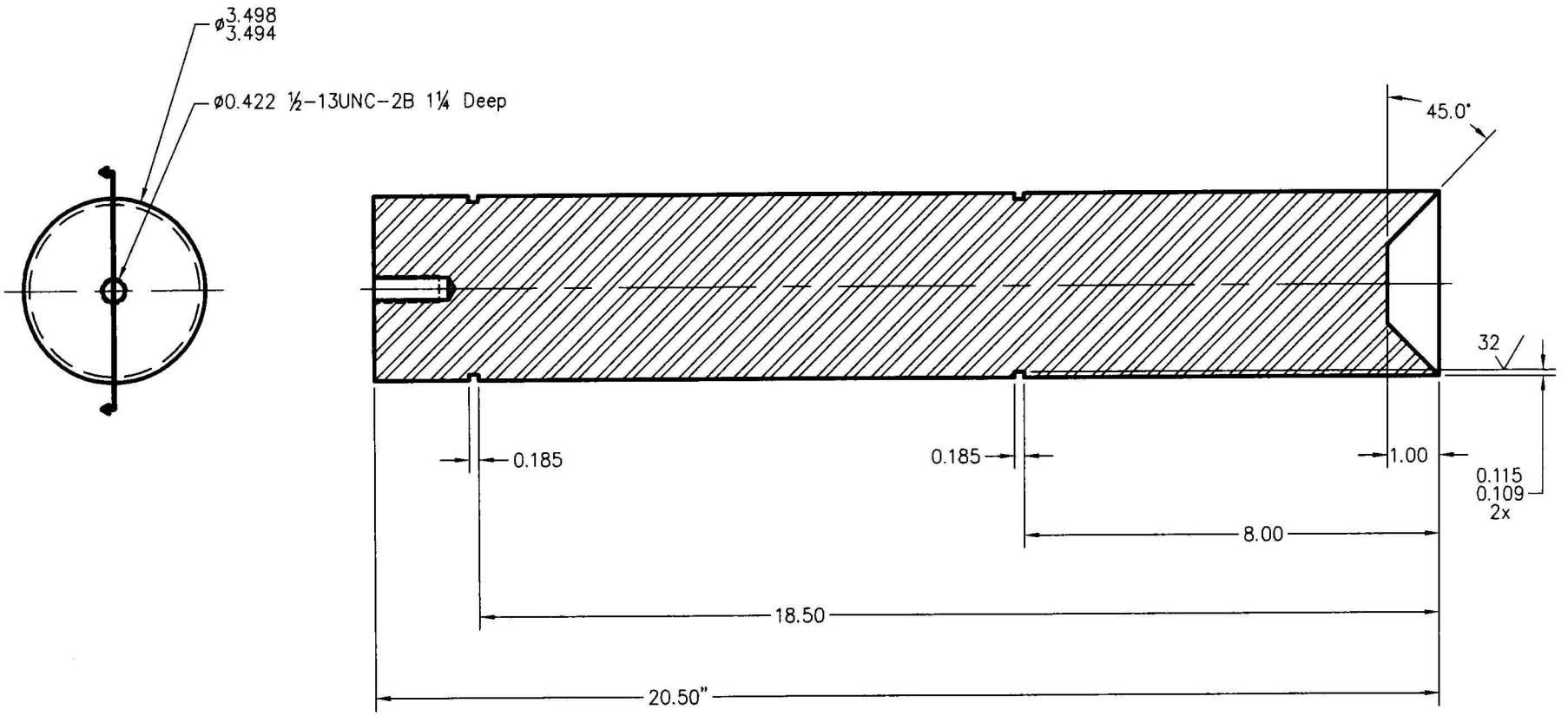
MATERIAL Zelux-M&HDP

SCALE 2:1

SHEET 2 of 2

A

DRAWING NUMBER LGG-158



Notes: Use High Density Polyethylene only
Provide mat'l cert. to customer

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS
FINISH 63

DRAWN	M. Long	DATE	10/04/01
ENGINEER		DATE	
APPROVED		DATE	
MATERIAL	H.D. POLY		

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: PISTON –1 Piece

SCALE	SHEET		DRAWING NUMBER
1:2	1 of 1	B	LGG–029

lgg 419: 6 turn magnet coils (first shot)
gain set to 0.4 on dial - some as recent shots
amplified magnet signals on scope 8, ch 1+2 (Tek 350)
est. 4.7 V pk raw magnet signals
simulated raw magnet signals are 3.3V pk
" amplified " " " 6.9V pk

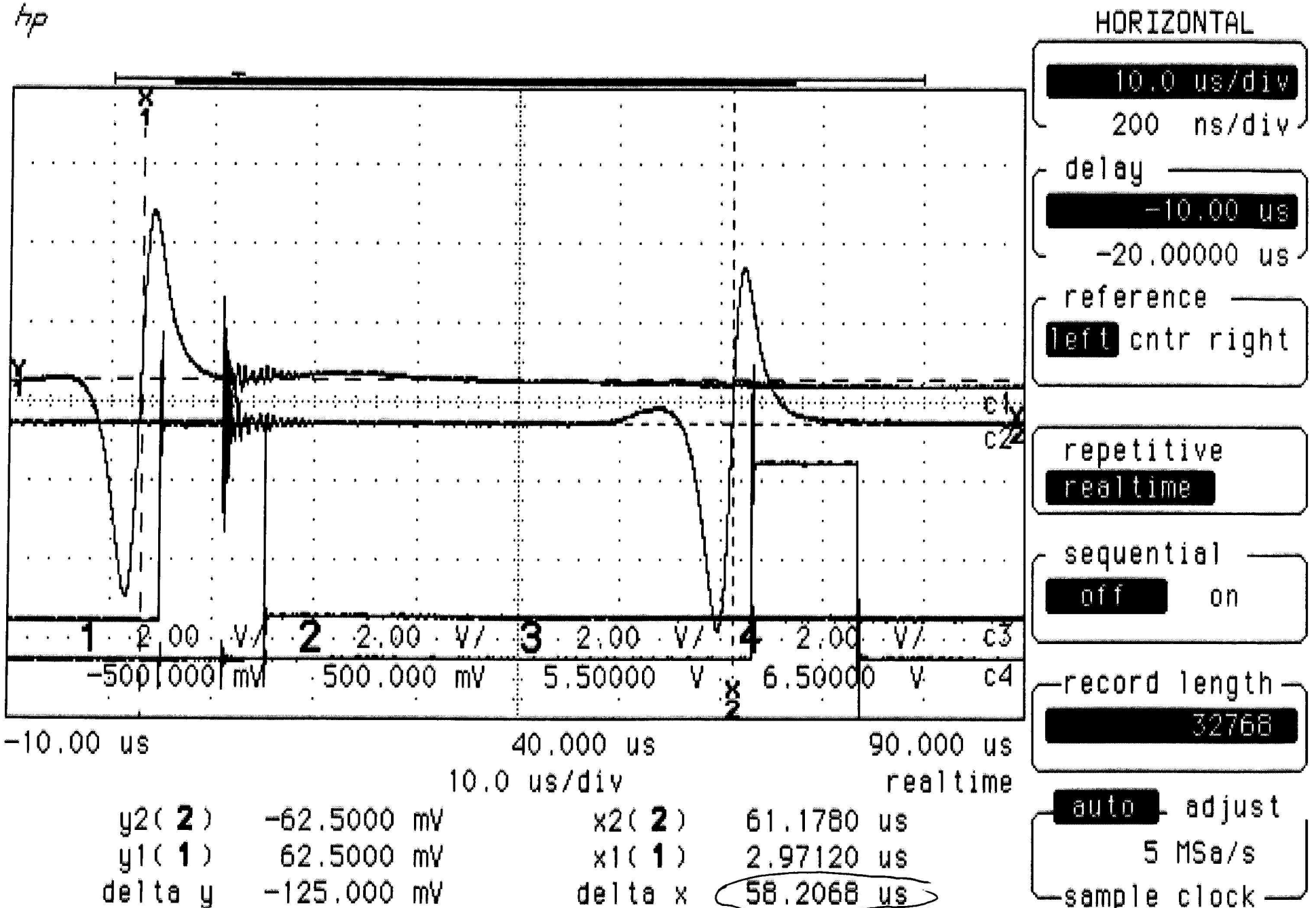
1/4/11 lgg 419: 5.5V pk actual raw magnet signal
> 8V pk amplified " "
(offscale, 2 V/div)

ref.: drop steel ball test: 6 turn coil = 43mV = 0.61
10 " " = 70mV

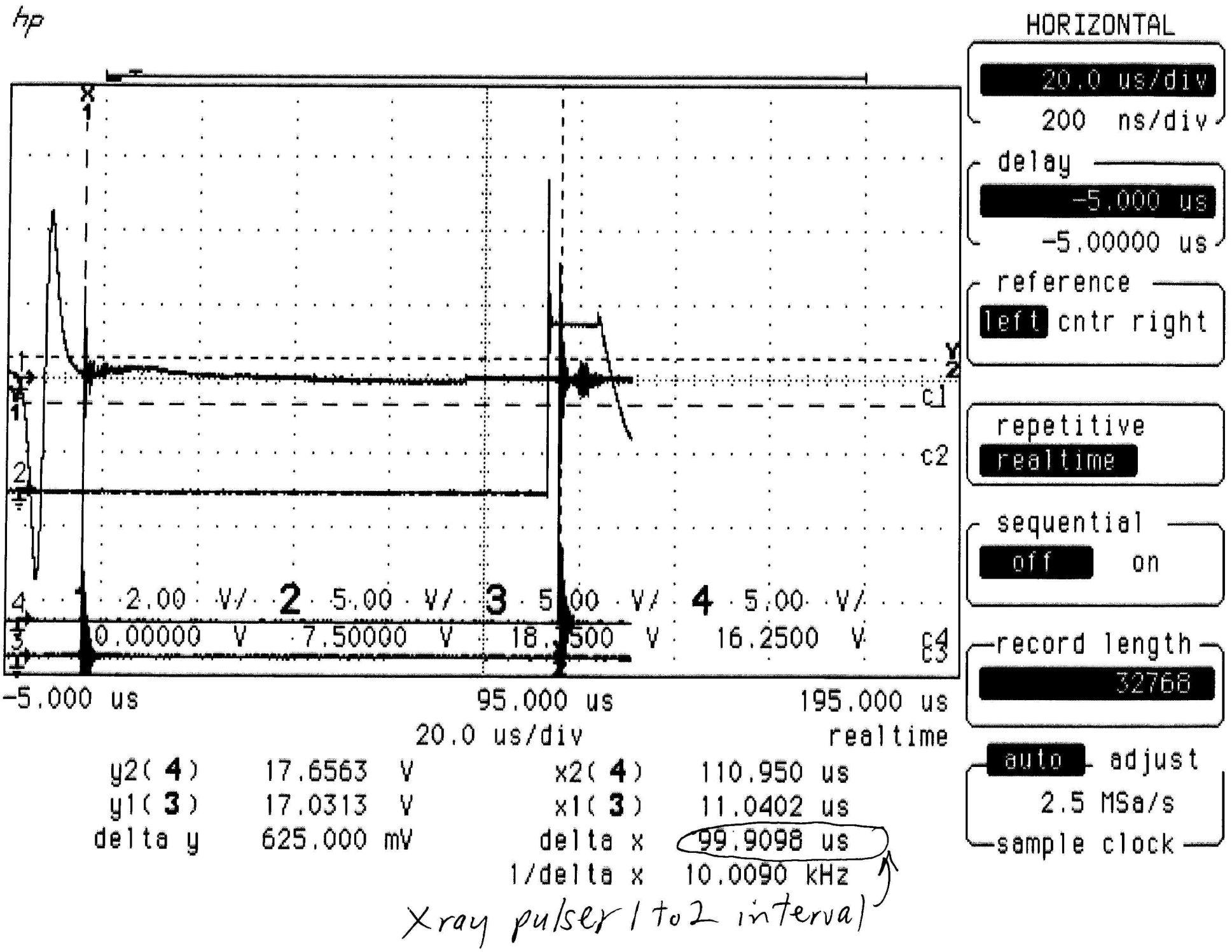
ref: lgg 403 ϕ 25.4mm flyer, 3756 m/s : magnet 1 pk = 8.5V
10 turn magnet coil gain 0.4 setting on dial ≈ gain of 2x signal

$\frac{3500}{3756} = \frac{7.9}{8.5}$ for 10 turns ≈ 4.7 V pk for 6 turns

Shot 419 HPS

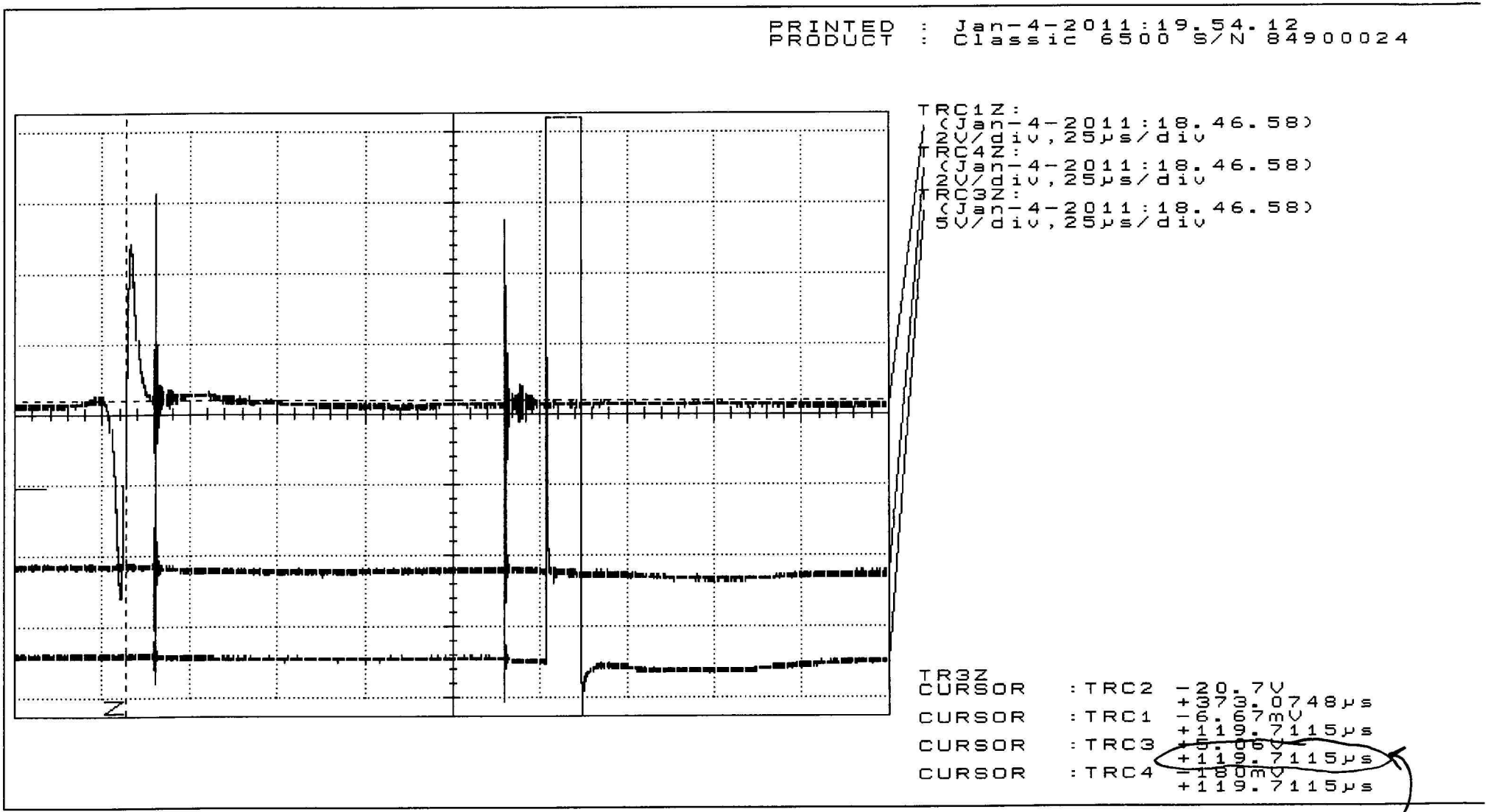

hp
HORIZONTAL
10.0 us/div
200 ns/div
delay
-10.00 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
5 MSa/s
sample clock
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/ c3
-500.000 mV 500.000 mV 5.50000 V 6.50000 V c4
-10.00 us 40.000 us 90.000 us
10.0 us/div realtime
y2(2) -62.5000 mV
y1(1) 62.5000 mV
delta y -125.000 mV
x2(2) 61.1780 us
x1(1) 2.97120 us
delta x 58.2068 us
1/delta x 17.1801 kHz
magnet 1 to magnet 2 interval

Shot 419 HP6



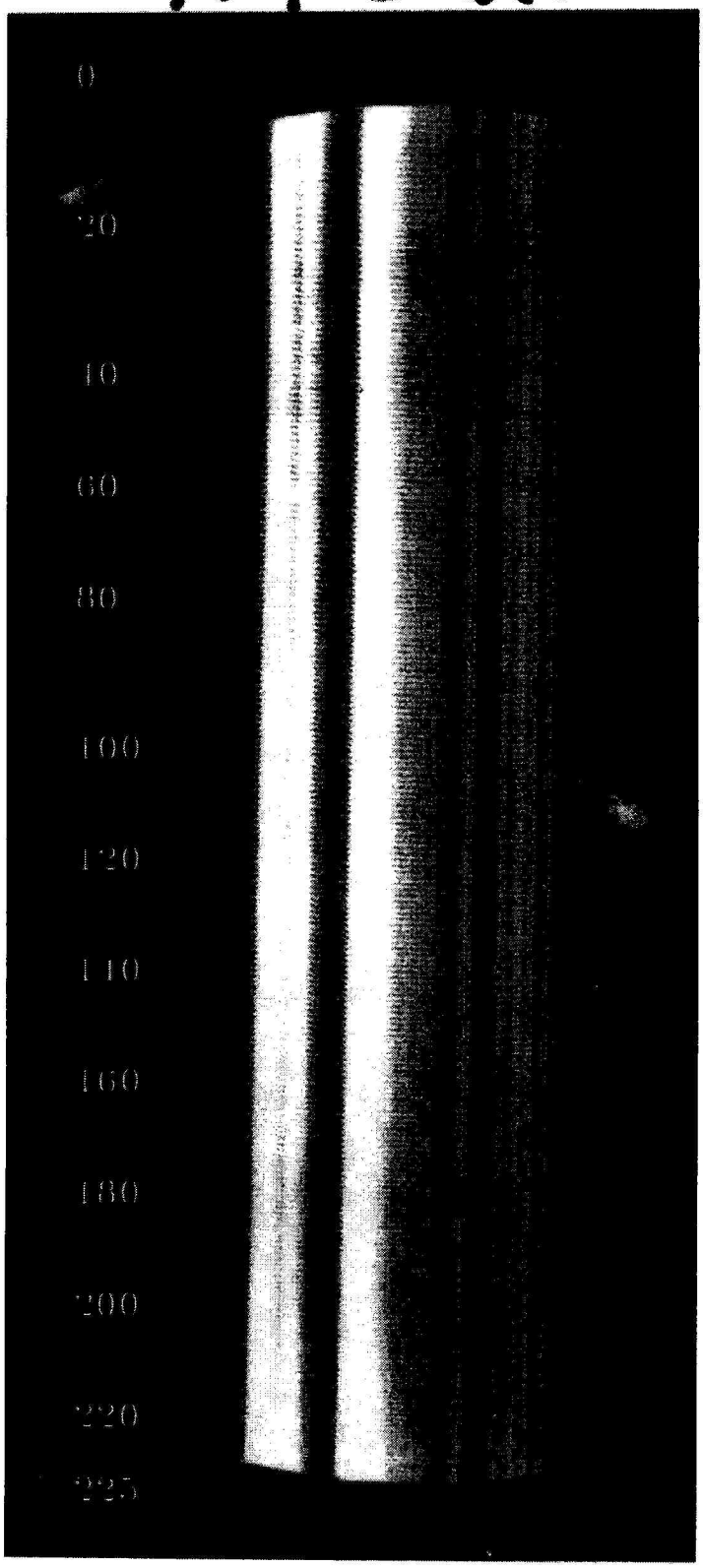
Xray pulser 1 to 2 interval

Shot 419 GS7



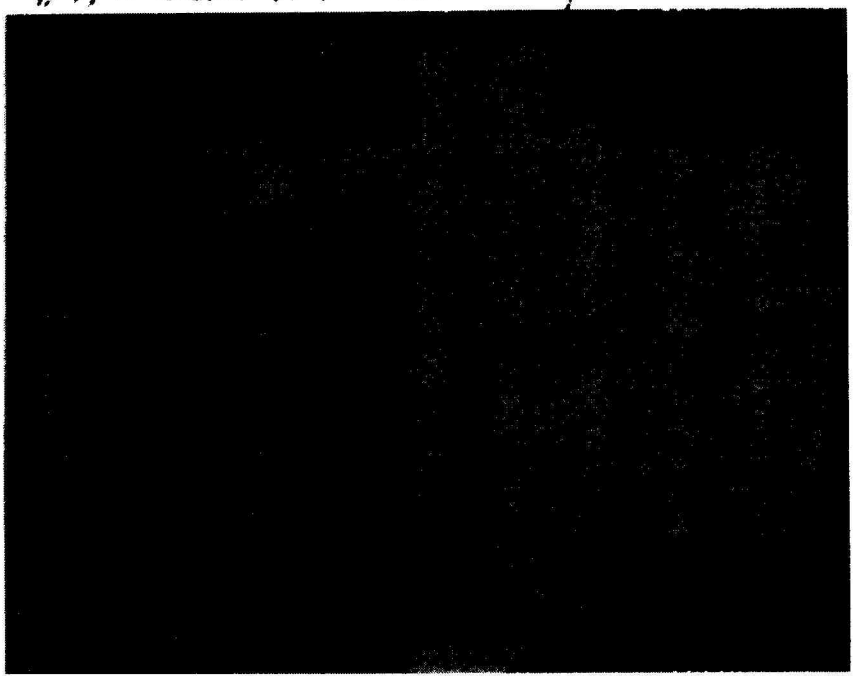
magnet 1 to camera trigger interval
camera trigger to camera monitor = 280ns

419 Cal.

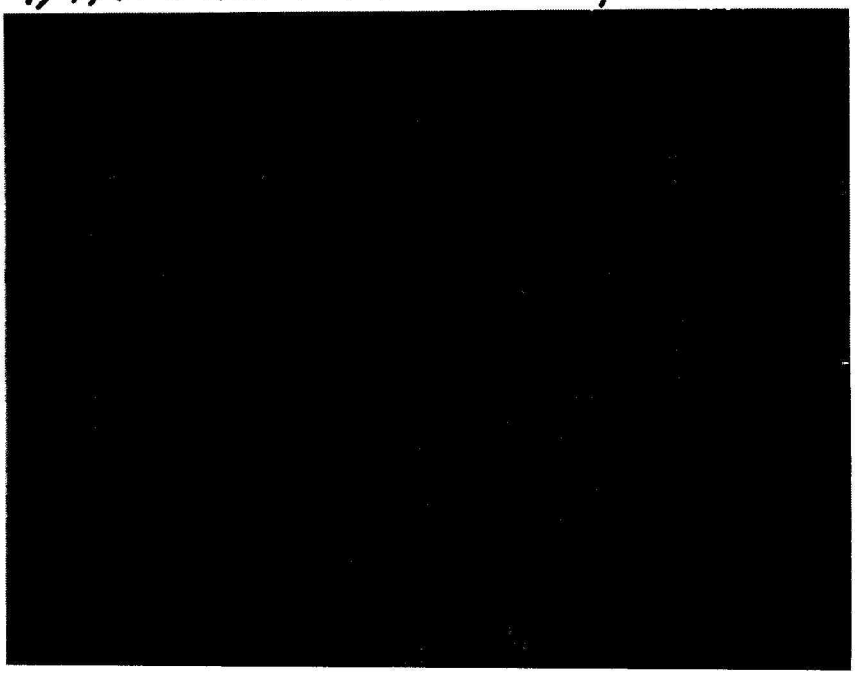


6.757 ns/ch × 225 = 1520 ns

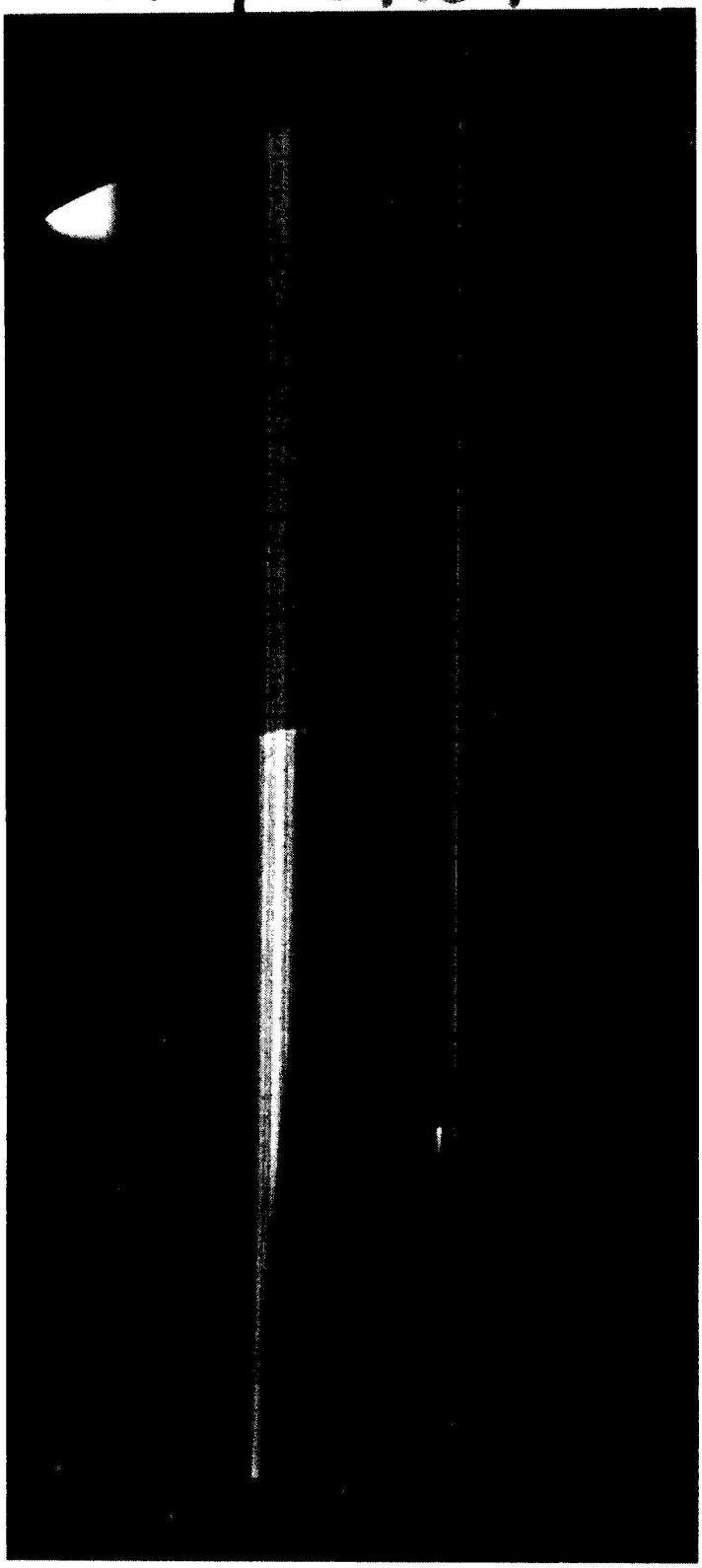
1/4/11 LGG 419 Flash X.ray #1



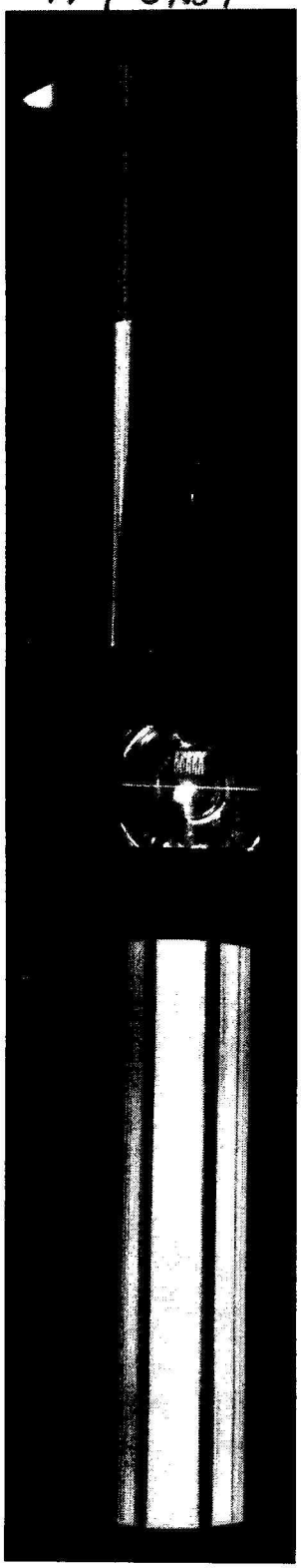
1/4/11 LGG 419 Flash X.ray #2



419 Shot



419 Shot



LIGHT GAS GUN DATA SHEET

Shot No. 454 Date 4/27/2012

Target:

Sample Material SAMPLE HOLDER# 26 FORSTERITE DISC#F Crystallographic orientation —

Source Location Morion, Created Gems Thickness:1 — in.

Type of Measurement EOS-PREHEATED 2. — in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height (shim to driver) — in. Driver Plate Thickness _____ in.
Material _____

Projectile:

Weight 20.251 gms. Length 0.9115 in. Skirt Diameter 1.1155 in.

Flyer Plate Material Mo Leading Edge Dia. 1.1004 in.

Thickness 0.0610 in. Major Dia. 0.9835 in. Depth Inserted — in.

Minor Dia. 0.927 in. Force 150 lbs Temp. 21°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth .109 in.

Diameter: Front 3.497 in. Back 3.498 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 583 gms. Type IMR 4350 Total Charge 595 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 5.0 km/sec Piston _____ km/sec

Notes: 95/95

sig. 0.145 ; 5 actual velocity 4.963 km/s
0.133

~5:30 .

L.G.G.

147.985

Camera Streak Duration: 1506 nsec Timing calibration frequency: 147.9993 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 24.8px/mm

Film Type: Streak Camera: ~~Polaroid Type 57~~ Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 2775 µsec Flash X-ray #2 73.404 µsec

? ~~Static Streak Photo~~ LAMP DELAY -6.37 µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0559 in. min.	0.0973 in. min.
0.0563 in. max.	0.0941 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: _____ µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	3.60 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

L.G.G.

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL		
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	502	µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1009	µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	41.000	µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	69.100	µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	78.527	µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	9.433	µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	69.112	µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	41.020	µsec
UDC Velocity:			4963.93	M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1	Velocity Magnet 2	41025.8	ns ~~µsec~~
HP5, 1-3:	Velocity Magnet 1	TTL Start	2041.8	ns ~~µsec~~
HP5, 2-4:	Velocity Magnet 2	TTL Stop	2030	ns ~~µsec~~
HP6, 1-2:	Velocity Magnet 1	Xenon Lamp Trigger	77276	ns ~~µsec~~
HP6, 3-4:	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	69109	ns ~~µsec~~
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	83638 ~~7542~~	ns ~~µsec~~
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	83877	ns ~~µsec~~

Shot 454 Nominal Timeline Preshot

| | | |

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	_____ µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	_____ µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	40.200 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	69.308 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	76.915 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7612 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	69.270 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	40.210 µsec
UDC Velocity:			5063.96 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1-2:	Velocity Magnet 1	Velocity magnet 2	40.216 µsec
HP5, 1-3:	Velocity Magnet 1	TTL Start	2002 µsec
HP5, 2-4:	Velocity Magnet 2	TTL Stop	1.999 µsec
HP6, 1-2:	Velocity Magnet 1	Xenon Lamp Trigger	75.629 µsec
HP6, 3-4:	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	69.269 µsec
GS7, 1-3:	Velocity Magnet 1	Camera Trigger (UDC HV 1)	81.974 µsec
GS7, 1-2:	Velocity Magnet 1	Camera Cal. Sig. (UDC HV 2)	82.654 µsec
GS7, 1-4:	Velocity Magnet 1	Camera Monitor Out	82.222 µsec

MAGNET DISTANCE

Shot No. **454** Expected Velocity: **5.00**

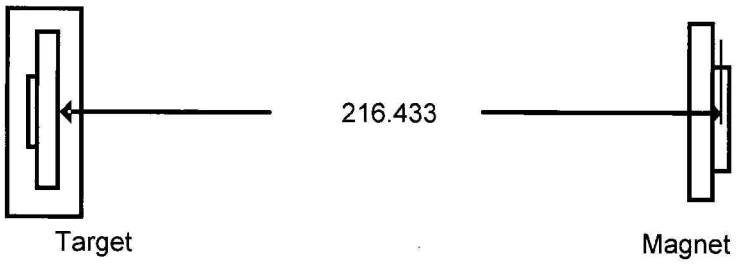
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **40.721 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.397 inch

Second measurement = 8.396 inch

Average measurement = 8.396 inch

Average measurement = 213.258 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

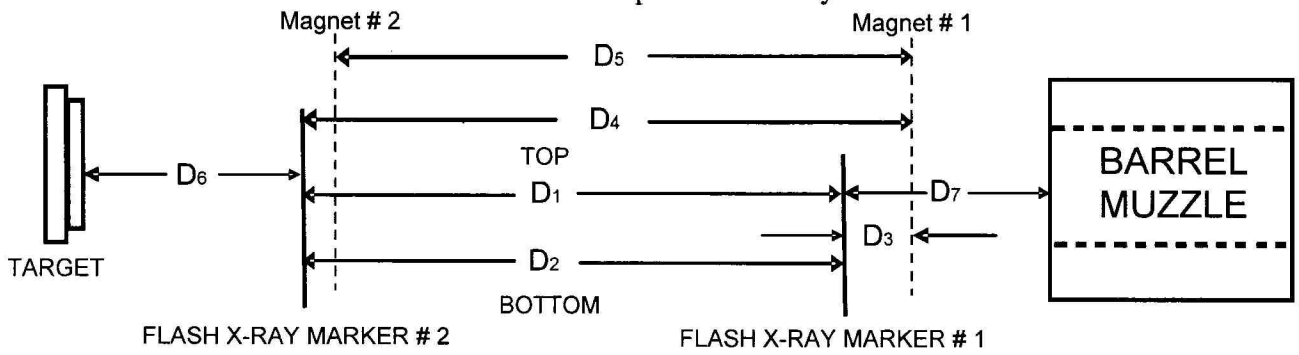
Distance Between Magnet # 2 to Target = 216.433 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **43.287 µsec.**

Fudged Distance between Magnet 2 to Target = 0 mm 0.201039

TARGET MEASUREMENT

Shot No. **454** Expected Velocity: **5.00** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	36.0	99.0
Measure # 2, mm	30.00	383.15	203.66	36.0	99.0
Average, mm	30.00	383.15	203.61	36.0	99.0
Travel time, µsec	**6.00**	**76.63**	**40.72**	**7.20**	**19.80**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

left over from x-ray timing for trigger

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **70.64** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **70.62** µsec.

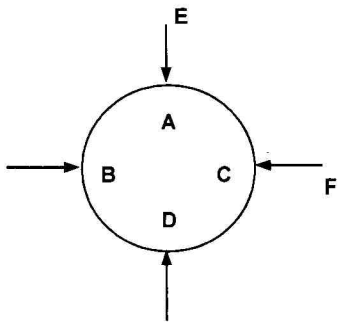
Flash X-Ray # 1 Delay (from Magnet # 1) **2.90** µsec. wksht calc: 2.775

Flash X-Ray # 2 Delay (from Magnet # 1) **73.98** µsec. 73.404

SHOT No. _ 454
LGG Moly Capsule Cap 11/18/2010
SAMPLE MATERIAL: Mo 26

Post polish

Thickness Measurement	
A	0.03065
A	0.03075
B	0.03070
B	0.03065
C	0.03055
C	0.03055
D	0.03055
D	0.03060



Diameter Measurement	
E	0.35450
E	0.35400
F	0.35350
F	0.35350
AVE	0.35388
Radius	0.1769

Statistic for thickness	
N	8
MAX	0.03075
MIN	0.0306
Range	0.0002
MEAN	0.03063
STDEV	7.55929E-05

Statistic for perimeter	
N	4
MAX	0.35450
MIN	0.3535
Range	0.001
MEAN	0.353875
STDEV	0.000478714

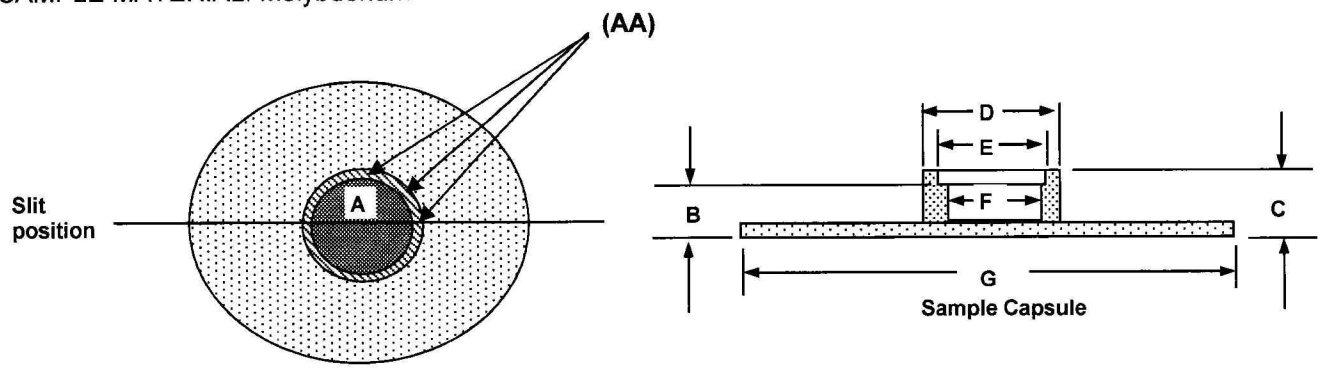
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.030625	±	mm	
	FLATNESS:		0.0002			
	VOLUME:		0.0494		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.0744		$grams/cm^3$	

SHOT No. 454 post polish

SAMPLE CAPSULE: 26

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04215
A	0.04230
A	0.04230
A	0.04225
Avg	0.04225

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17155
C	0.17165
C	0.17175
C	0.17165
D	0.3960
D	0.3960

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14300
B point 2	0.14300
B point 3	0.14150
B point 4	0.14305
B point 5	0.14300
B point 6	0.14300
B point 7	0.14295
B point 8	0.14300

Statistics

N	8
MAX	0.14305
MIN	0.14150
Range	0.00155
Average	0.14281

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3535
F	0.3140
F	0.3140
G	1.3595
G	1.3595
H	0.10056

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SHOT No. _____454_____ tip used: .7mm long/ flat tip

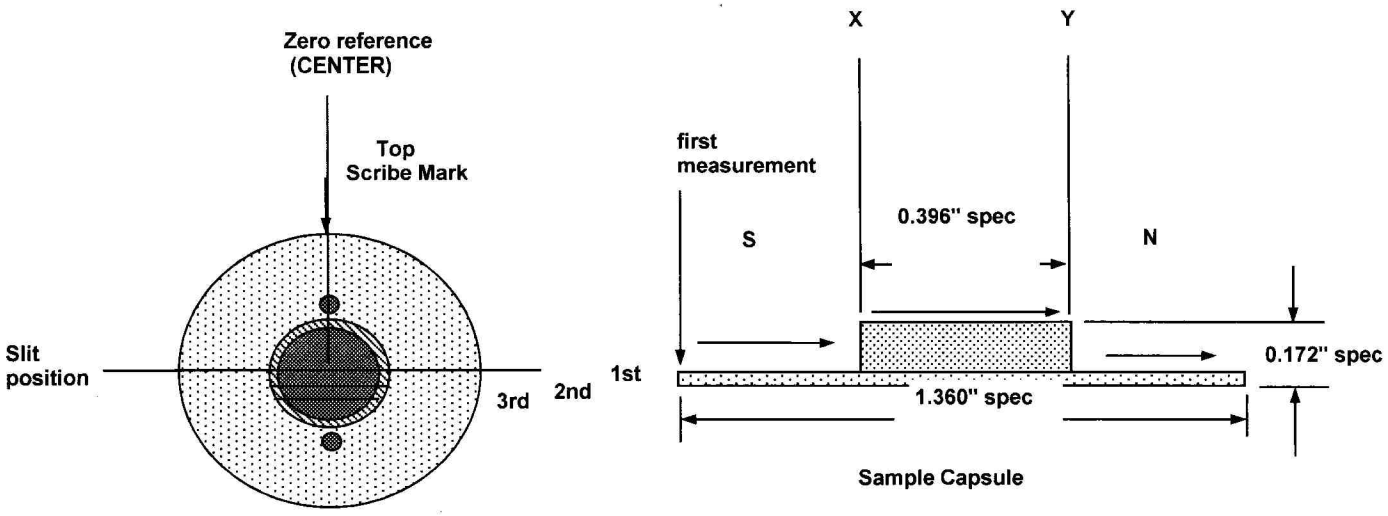
SAMPLE CAPSULE: 26 note: the platform on which the measurement was taken

SAMPLE MATERIAL: deviates from flat by +0.013 max.

direction of measurement

4.849

THICKNESS PROFILE (Not re-polished, but final surface) 1.792



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00011

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00000

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

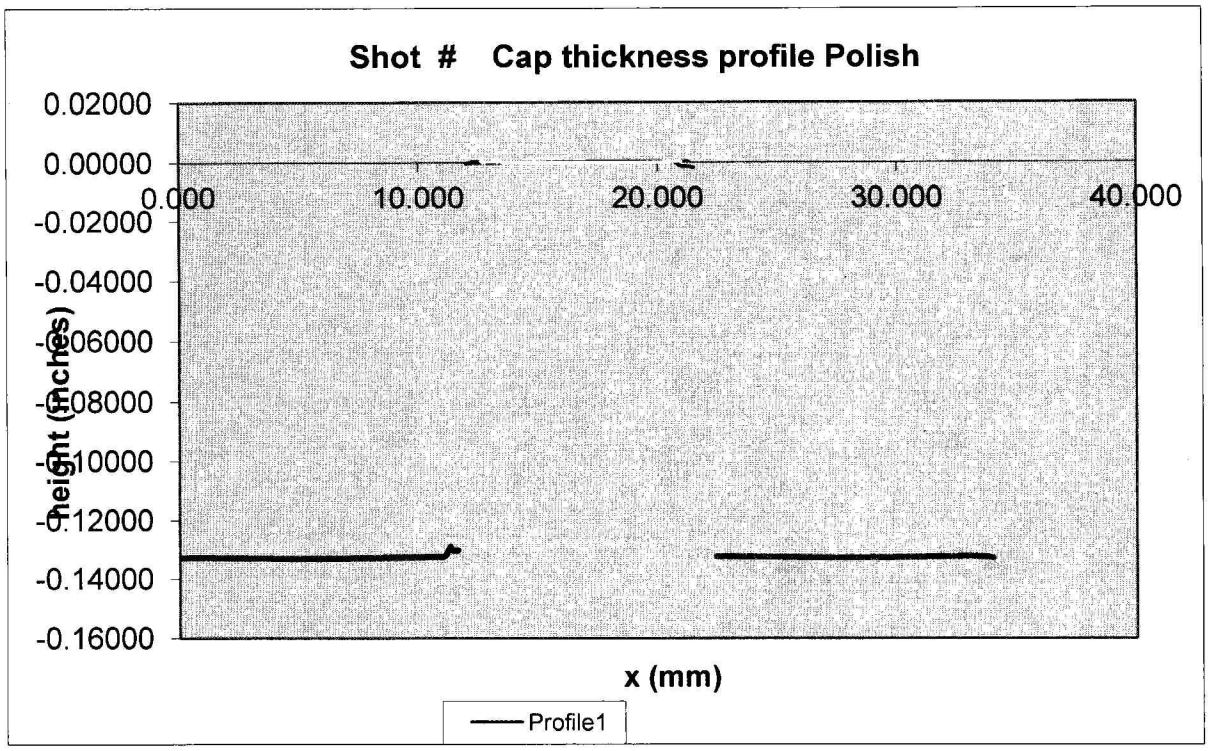
Average thickness reading = 0.00000

Note: Measurement from reference zero point from the base is = **0.1733** Inches
4.4018 mm

Average thickness of the driver Plate = 0.0405 Inches
1.0287 mm

Thickness of the Carbon Deposited on the coil side is = 48.70 nm

Thickness of the C Deposited on the Projectile side is = 50.20 nm


Shot # Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
-0.16000
0.000
10.000
20.000
30.000
40.000
height (inches)
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM i

3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s	# reading	dist(mm)
1	0.000	17.000	-0.13320	225	22.400	-5.400	-0.13250	118	11.700
2	0.100	16.900	-0.13315	226	22.500	-5.500	-0.13250	119	11.800
3	0.200	16.800	-0.13310	227	22.600	-5.600	-0.13255	120	11.900
4	0.300	16.700	-0.13305	228	22.700	-5.700	-0.13250	121	12.000
5	0.400	16.600	-0.13300	229	22.800	-5.800	-0.13250	122	12.100
6	0.500	16.500	-0.13300	230	22.900	-5.900	-0.13250	123	12.200
7	0.600	16.400	-0.13295	231	23.000	-6.000	-0.13255	124	12.300
8	0.700	16.300	-0.13295	232	23.100	-6.100	-0.13250	125	12.400
9	0.800	16.200	-0.13295	233	23.200	-6.200	-0.13255	126	12.500
10	0.900	16.100	-0.13295	234	23.300	-6.300	-0.13260	127	12.600
11	1.000	16.000	-0.13295	235	23.400	-6.400	-0.13260	128	12.700
12	1.100	15.900	-0.13295	236	23.500	-6.500	-0.13255	129	12.800
13	1.200	15.800	-0.13295	237	23.600	-6.600	-0.13255	130	12.900
14	1.300	15.700	-0.13300	238	23.700	-6.700	-0.13260	131	13.000
15	1.400	15.600	-0.13300	239	23.800	-6.800	-0.13260	132	13.100
16	1.500	15.500	-0.13305	240	23.900	-6.900	-0.13260	133	13.200
17	1.600	15.400	-0.13305	241	24.000	-7.000	-0.13260	134	13.300
18	1.700	15.300	-0.13305	242	24.100	-7.100	-0.13265	135	13.400
19	1.800	15.200	-0.13305	243	24.200	-7.200	-0.13265	136	13.500
20	1.900	15.100	-0.13305	244	24.300	-7.300	-0.13260	137	13.600
21	2.000	15.000	-0.13310	245	24.400	-7.400	-0.13265	138	13.700
22	2.100	14.900	-0.13310	246	24.500	-7.500	-0.13270	139	13.800
23	2.200	14.800	-0.13310	247	24.600	-7.600	-0.13265	140	13.900
24	2.300	14.700	-0.13315	248	24.700	-7.700	-0.13270	141	14.000
25	2.400	14.600	-0.13315	249	24.800	-7.800	-0.13270	142	14.100
26	2.500	14.500	-0.13315	250	24.900	-7.900	-0.13270	143	14.200
27	2.600	14.400	-0.13310	251	25.000	-8.000	-0.13275	144	14.300
28	2.700	14.300	-0.13315	252	25.100	-8.100	-0.13270	145	14.400
29	2.800	14.200	-0.13315	253	25.200	-8.200	-0.13275	146	14.500
30	2.900	14.100	-0.13320	254	25.300	-8.300	-0.13275	147	14.600
31	3.000	14.000	-0.13320	255	25.400	-8.400	-0.13280	148	14.700
32	3.100	13.900	-0.13325	256	25.500	-8.500	-0.13275	149	14.800
33	3.200	13.800	-0.13325	257	25.600	-8.600	-0.13280	150	14.900
34	3.300	13.700	-0.13325	258	25.700	-8.700	-0.13280	151	15.000
35	3.400	13.600	-0.13325	259	25.800	-8.800	-0.13280	152	15.100
36	3.500	13.500	-0.13325	260	25.900	-8.900	-0.13280	153	15.200
37	3.600	13.400	-0.13325	261	26.000	-9.000	-0.13285	154	15.300
38	3.700	13.300	-0.13330	262	26.100	-9.100	-0.13280	155	15.400
39	3.800	13.200	-0.13325	263	26.200	-9.200	-0.13285	156	15.500
40	3.900	13.100	-0.13330	264	26.300	-9.300	-0.13280	157	15.600
41	4.000	13.000	-0.13335	265	26.400	-9.400	-0.13285	158	15.700
42	4.100	12.900	-0.13335	266	26.500	-9.500	-0.13285	159	15.800
43	4.200	12.800	-0.13330	267	26.600	-9.600	-0.13285	160	15.900
44	4.300	12.700	-0.13335	268	26.700	-9.700	-0.13290	161	16.000
45	4.400	12.600	-0.13330	269	26.800	-9.800	-0.13290	162	16.100
46	4.500	12.500	-0.13330	270	26.900	-9.900	-0.13285	163	16.200
47	4.600	12.400	-0.13335	271	27.000	-10.000	-0.13290	164	16.300
48	4.700	12.300	-0.13335	272	27.100	-10.100	-0.13285	165	16.400
49	4.800	12.200	-0.13335	273	27.200	-10.200	-0.13285	166	16.500
50	4.900	12.100	-0.13335	274	27.300	-10.300	-0.13285	167	16.600
51	5.000	12.000	-0.13335	275	27.400	-10.400	-0.13295	168	16.700
52	5.100	11.900	-0.13335	276	27.500	-10.500	-0.13285	169	16.800
53	5.200	11.800	-0.13335	277	27.600	-10.600	-0.13290	170	16.900
54	5.300	11.700	-0.13335	278	27.700	-10.700	-0.13295	171	17.000
55	5.400	11.600	-0.13335	279	27.800	-10.800	-0.13290	172	17.100
56	5.500	11.500	-0.13335	280	27.900	-10.900	-0.13285	173	17.200
57	5.600	11.400	-0.13335	281	28.000	-11.000	-0.13290	174	17.300

58	5.700	11.300	-0.13330	282	28.100	-11.100	-0.13285	175	17.400
59	5.800	11.200	-0.13330	283	28.200	-11.200	-0.13285	176	17.500
60	5.900	11.100	-0.13330	284	28.300	-11.300	-0.13285	177	17.600
61	6.000	11.000	-0.13330	285	28.400	-11.400	-0.13285	178	17.700
62	6.100	10.900	-0.13330	286	28.500	-11.500	-0.13290	179	17.800
63	6.200	10.800	-0.13325	287	28.600	-11.600	-0.13285	180	17.900
64	6.300	10.700	-0.13325	288	28.700	-11.700	-0.13285	181	18.000
65	6.400	10.600	-0.13325	289	28.800	-11.800	-0.13285	182	18.100
66	6.500	10.500	-0.13325	290	28.900	-11.900	-0.13280	183	18.200
67	6.600	10.400	-0.13325	291	29.000	-12.000	-0.13280	184	18.300
68	6.700	10.300	-0.13325	292	29.100	-12.100	-0.13285	185	18.400
69	6.800	10.200	-0.13320	293	29.200	-12.200	-0.13280	186	18.500
70	6.900	10.100	-0.13325	294	29.300	-12.300	-0.13280	187	18.600
71	7.000	10.000	-0.13320	295	29.400	-12.400	-0.13280	188	18.700
72	7.100	9.900	-0.13320	296	29.500	-12.500	-0.13280	189	18.800
73	7.200	9.800	-0.13315	297	29.600	-12.600	-0.13280	190	18.900
74	7.300	9.700	-0.13315	298	29.700	-12.700	-0.13275	191	19.000
75	7.400	9.600	-0.13310	299	29.800	-12.800	-0.13280	192	19.100
76	7.500	9.500	-0.13315	300	29.900	-12.900	-0.13270	193	19.200
77	7.600	9.400	-0.13305	301	30.000	-13.000	-0.13270	194	19.300
78	7.700	9.300	-0.13305	302	30.100	-13.100	-0.13270	195	19.400
79	7.800	9.200	-0.13305	303	30.200	-13.200	-0.13270	196	19.500
80	7.900	9.100	-0.13305	304	30.300	-13.300	-0.13265	197	19.600
81	8.000	9.000	-0.13305	305	30.400	-13.400	-0.13265	198	19.700
82	8.100	8.900	-0.13305	306	30.500	-13.500	-0.13260	199	19.800
83	8.200	8.800	-0.13300	307	30.600	-13.600	-0.13260	200	19.900
84	8.300	8.700	-0.13295	308	30.700	-13.700	-0.13260	201	20.000
85	8.400	8.600	-0.13295	309	30.800	-13.800	-0.13255	202	20.100
86	8.500	8.500	-0.13295	310	30.900	-13.900	-0.13255	203	20.200
87	8.600	8.400	-0.13290	311	31.000	-14.000	-0.13255	204	20.300
88	8.700	8.300	-0.13295	312	31.100	-14.100	-0.13255	205	20.400
89	8.800	8.200	-0.13290	313	31.200	-14.200	-0.13250	206	20.500
90	8.900	8.100	-0.13285	314	31.300	-14.300	-0.13245	207	20.600
91	9.000	8.000	-0.13285	315	31.400	-14.400	-0.13245	208	20.700
92	9.100	7.900	-0.13285	316	31.500	-14.500	-0.13245	209	20.800
93	9.200	7.800	-0.13285	317	31.600	-14.600	-0.13245	210	20.900
94	9.300	7.700	-0.13285	318	31.700	-14.700	-0.13240	211	21.000
95	9.400	7.600	-0.13280	319	31.800	-14.800	-0.13235	212	21.100
96	9.500	7.500	-0.13280	320	31.900	-14.900	-0.13235	213	21.200
97	9.600	7.400	-0.13280	321	32.000	-15.000	-0.13240	214	21.300
98	9.700	7.300	-0.13275	322	32.100	-15.100	-0.13235	215	21.400
99	9.800	7.200	-0.13275	323	32.200	-15.200	-0.13230	216	21.500
100	9.900	7.100	-0.13275	324	32.300	-15.300	-0.13230	217	21.600
101	10.000	7.000	-0.13275	325	32.400	-15.400	-0.13230	218	21.700
102	10.100	6.900	-0.13275	326	32.500	-15.500	-0.13230	219	21.800
103	10.200	6.800	-0.13275	327	32.600	-15.600	-0.13230	220	21.900
104	10.300	6.700	-0.13270	328	32.700	-15.700	-0.13230	221	22.000
105	10.400	6.600	-0.13270	329	32.800	-15.800	-0.13225	222	22.100
106	10.500	6.500	-0.13270	330	32.900	-15.900	-0.13230	223	22.200
107	10.600	6.400	-0.13265	331	33.000	-16.000	-0.13225	224	22.300
108	10.700	6.300	-0.13265	332	33.100	-16.100	-0.13230		
109	10.800	6.200	-0.13260	333	33.200	-16.200	-0.13230		
110	10.900	6.100	-0.13265	334	33.300	-16.300	-0.13230		
111	11.000	6.000	-0.13270	335	33.400	-16.400	-0.13240		
112	11.100	5.900	-0.13225	336	33.500	-16.500	-0.13240		
113	11.200	5.800	-0.13045	337	33.600	-16.600	-0.13250		
114	11.300	5.700	-0.12920	338	33.700	-16.700	-0.13255		
115	11.400	5.600	-0.13045	339	33.800	-16.800	-0.13260		
116	11.500	5.500	-0.13045	340	33.900	-16.900	-0.13275		
117	11.600	5.400	-0.13045	341	34.000	-17.000	-0.13285		

ncrement

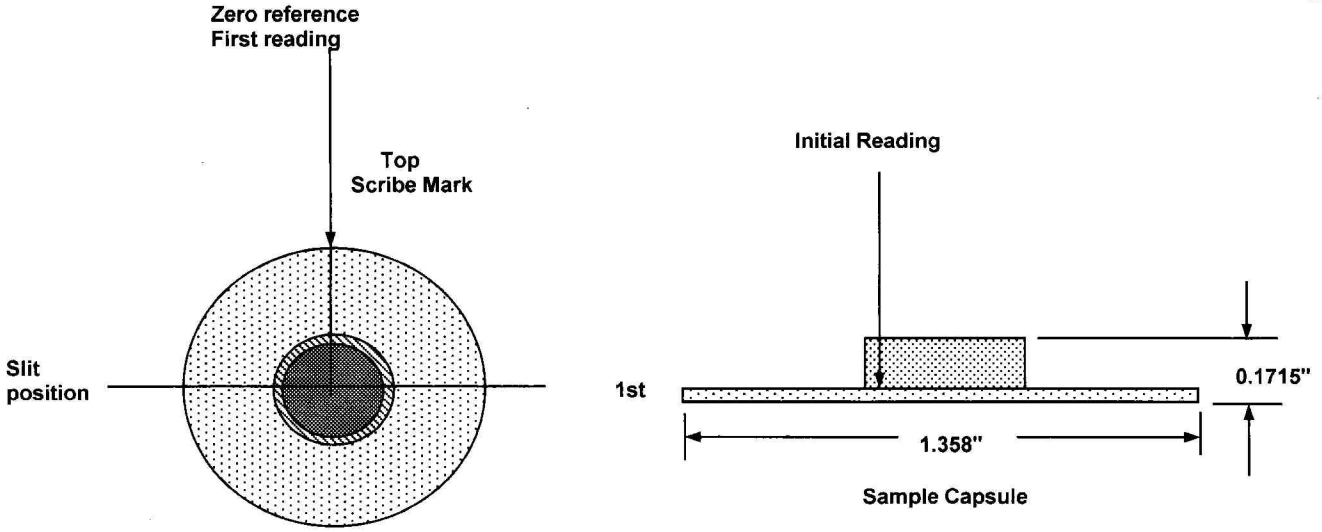
absdist(mm	1st	2nd	3 rd
5.300	Run	Run	Run
5.200	Reading	Reading	Reading
5.100	Inches	Inches	Inches
5.000			
4.900			
4.800			
4.700	-0.00060		
4.600	-0.00035		
4.500	-0.00030	0.00000	
4.400	-0.00025	0.00000	
4.300	-0.00020	0.00000	
4.200	-0.00020	0.00000	
4.100	-0.00020	0.00000	0.00000
4.000	-0.00015	0.00000	0.00000
3.900	-0.00010	0.00000	0.00000
3.800	-0.00020	0.00000	0.00000
3.700	-0.00020	0.00000	0.00000
3.600	-0.00020	0.00000	0.00000
3.500	-0.00020	0.00000	0.00000
3.400	-0.00015	0.00000	0.00000
3.300	-0.00020	0.00000	0.00000
3.200	-0.00015	0.00000	0.00000
3.100	-0.00015	0.00000	0.00000
3.000	-0.00010	0.00000	0.00000
2.900	-0.00010	0.00000	0.00000
2.800	-0.00010	0.00000	0.00000
2.700	-0.00010	0.00000	0.00000
2.600	-0.00010	0.00000	0.00000
2.500	-0.00010	0.00000	0.00000
2.400	-0.00005	0.00000	0.00000
2.300	-0.00005	0.00000	0.00000
2.200	-0.00005	0.00000	0.00000
2.100	0.00000	0.00000	0.00000
2.000	-0.00005	0.00000	0.00000
1.900	0.00000	0.00000	0.00000
1.800	0.00000	0.00000	0.00000
1.700	0.00000	0.00000	0.00000
1.600	0.00000	0.00000	0.00000
1.500	0.00000	0.00000	0.00000
1.400	0.00000	0.00000	0.00000
1.300	0.00005	0.00000	0.00000
1.200	0.00005	0.00000	0.00000
1.100	0.00000	0.00000	0.00000
1.000	0.00005	0.00000	0.00000
0.900	0.00005	0.00000	0.00000
0.800	0.00010	0.00000	0.00000
0.700	0.00005	0.00000	0.00000
0.600	0.00005	0.00000	0.00000
0.500	0.00005	0.00000	0.00000
0.400	0.00005	0.00000	0.00000
0.300	0.00010	0.00000	0.00000
0.200	0.00010	0.00000	0.00000
0.100	0.00010	0.00000	0.00000
0.000	0.00010	0.00000	0.00000
-0.100	0.00010	0.00000	0.00000
-0.200	0.00010	0.00000	0.00000
-0.300	0.00010	0.00000	0.00000

-0.400	0.00015	0.00000	0.00000
-0.500	0.00015	0.00000	0.00000
-0.600	0.00020	0.00000	0.00000
-0.700	0.00015	0.00000	0.00000
-0.800	0.00015	0.00000	0.00000
-0.900	0.00015	0.00000	0.00000
-1.000	0.00015	0.00000	0.00000
-1.100	0.00010	0.00000	0.00000
-1.200	0.00020	0.00000	0.00000
-1.300	0.00015	0.00000	0.00000
-1.400	0.00015	0.00000	0.00000
-1.500	0.00015	0.00000	0.00000
-1.600	0.00015	0.00000	0.00000
-1.700	0.00020	0.00000	0.00000
-1.800	0.00015	0.00000	0.00000
-1.900	0.00015	0.00000	0.00000
-2.000	0.00015	0.00000	0.00000
-2.100	0.00015	0.00000	0.00000
-2.200	0.00015	0.00000	0.00000
-2.300	0.00010	0.00000	0.00000
-2.400	0.00015	0.00000	0.00000
-2.500	0.00015	0.00000	0.00000
-2.600	0.00010	0.00000	0.00000
-2.700	0.00010	0.00000	0.00000
-2.800	0.00015	0.00000	0.00000
-2.900	0.00010	0.00000	0.00000
-3.000	0.00015	0.00000	0.00000
-3.100	0.00010	0.00000	0.00000
-3.200	0.00010	0.00000	0.00000
-3.300	0.00010	0.00000	0.00000
-3.400	0.00010	0.00000	0.00000
-3.500	0.00005	0.00000	0.00000
-3.600	0.00000	0.00000	0.00000
-3.700	0.00000	0.00000	0.00000
-3.800	0.00000	0.00000	0.00000
-3.900	-0.00010	0.00000	0.00000
-4.000	-0.00010	0.00000	0.00000
-4.100	-0.00035	0.00000	0.00000
-4.200	-0.00110	0.00000	0.00000
-4.300	-0.00155	0.00000	0.00000
-4.400	-0.00150	0.00000	
-4.500	-0.00155	0.00000	
-4.600	-0.00155	0.00000	
-4.700	-0.00175		
-4.800	-0.00195		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			

SAMPLE CAPSULE: **26**
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

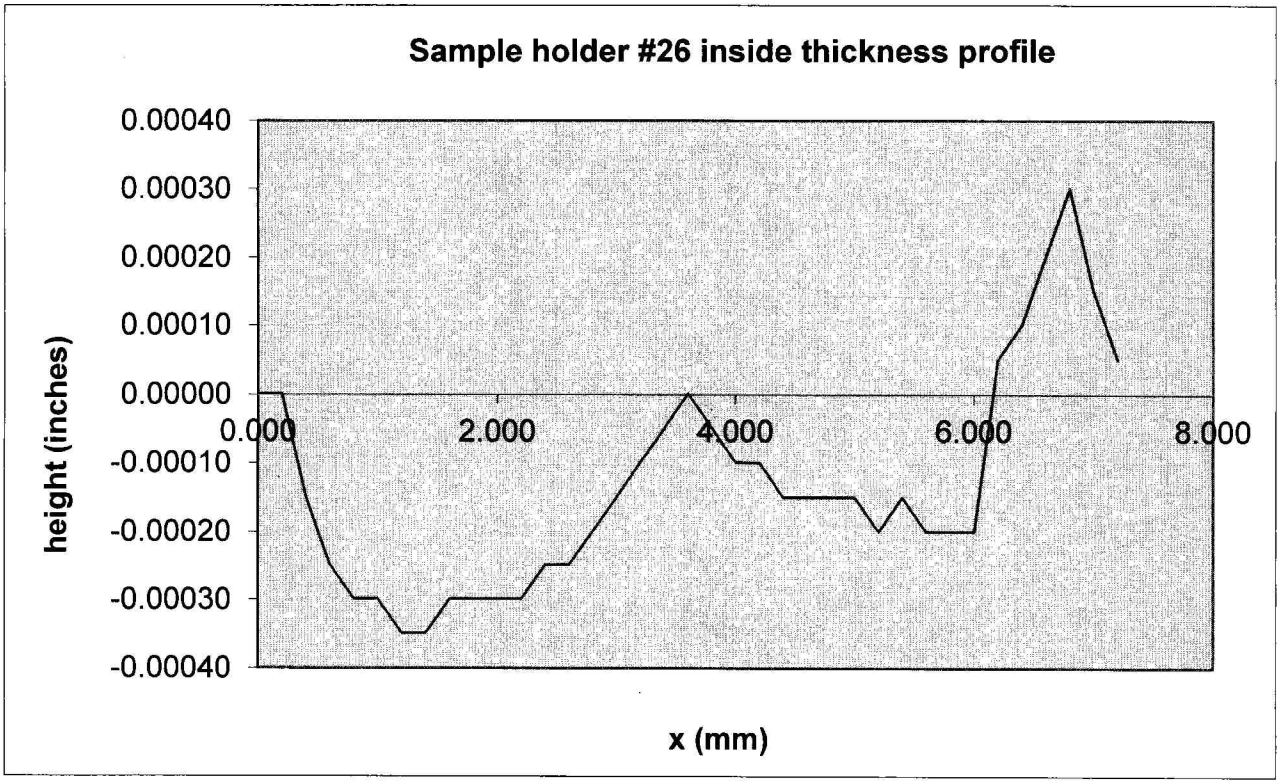
4.6625
4.623



1.338582677

Average thickness reading = -0.00013

Note: The thickness of the reference zero point from the base is = **0.04185** Inches
1.06299 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00000	3.6	south
2	0.200	0.00000	3.40	
3	0.400	-0.00015	3.20	
4	0.600	-0.00025	3.00	
5	0.800	-0.00030	2.80	
6	1.000	-0.00030	2.60	
7	1.200	-0.00035	2.40	
8	1.400	-0.00035	2.20	
9	1.600	-0.00030	2.00	
10	1.800	-0.00030	1.80	
11	2.000	-0.00030	1.60	
12	2.200	-0.00030	1.40	
13	2.400	-0.00025	1.20	
14	2.600	-0.00025	1.00	
15	2.800	-0.00020	0.80	
16	3.000	-0.00015	0.60	
17	3.200	-0.00010	0.40	
18	3.400	-0.00005	0.20	
19	3.600	0.00000	0.00	
20	3.800	-0.00005	-0.20	
21	4.000	-0.00010	-0.40	
22	4.200	-0.00010	-0.60	
23	4.400	-0.00015	-0.80	
24	4.600	-0.00015	-1.00	
25	4.800	-0.00015	-1.20	
26	5.000	-0.00015	-1.40	
27	5.200	-0.00020	-1.60	
28	5.400	-0.00015	-1.80	
29	5.600	-0.00020	-2.00	
30	5.800	-0.00020	-2.20	
31	6.000	-0.00020	-2.40	
32	6.200	0.00005	-2.60	
33	6.400	0.00010	-2.80	
34	6.600	0.00020	-3.00	
35	6.800	0.00030	-3.20	
36	7.000	0.00015	-3.40	
37	7.200	0.00005	-3.60	north

Carbon coating
2/28/2012
Claire Thomas

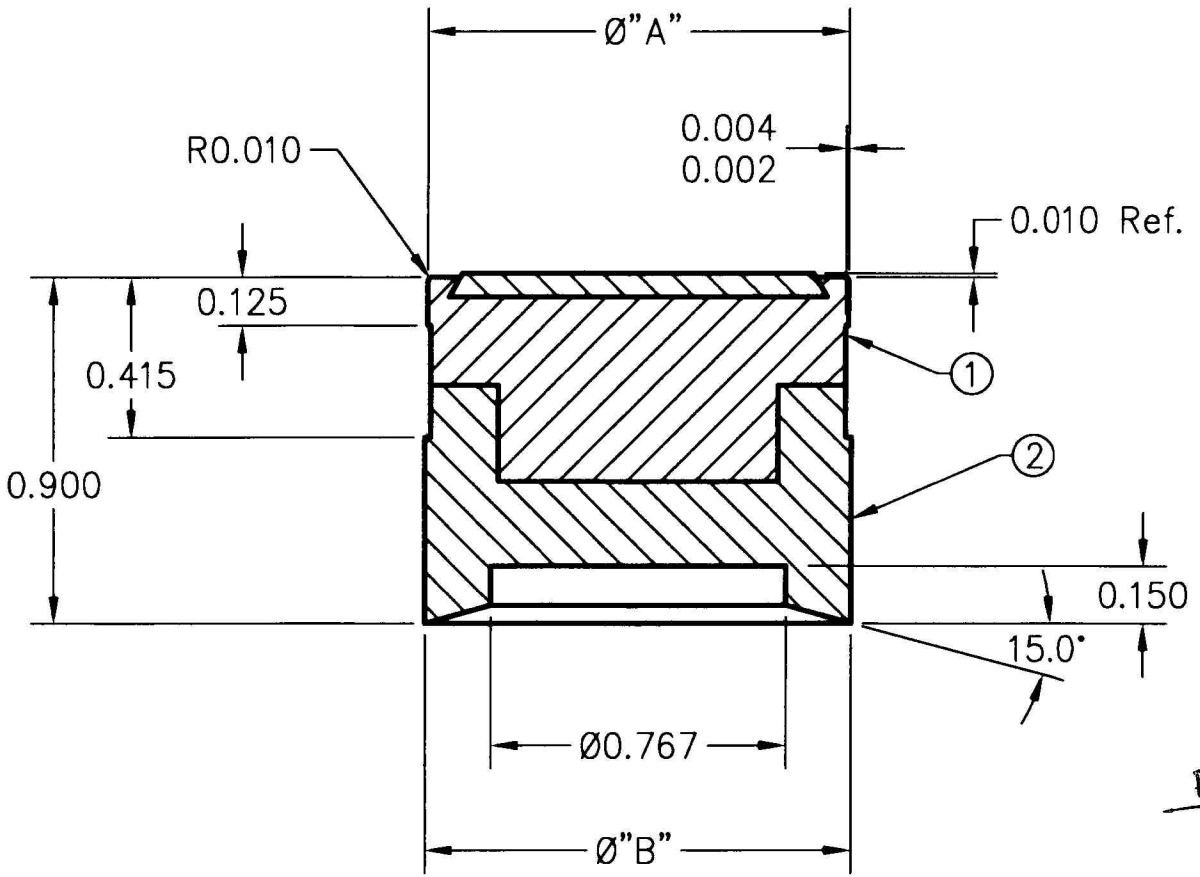
		No. of coatings					
Sample Holder		**1**	**2**	**3**	**4**	**5**	**6**
Fo 26,27,28	sample-side	9.3	6.8	6.9	6.5	8.9	10.3
	projectile (driver) side	7.3	10.3	7	8.5	8.2	8.9

Total

48.7

50.2

FLYER # 2 3 (Mc)
PRESSED 3/1/12



Note: Super Glue & Press Fit 1 & 2

SHOT#		
A	1.1004	+.0000 −.0005
B	1.1158	+.0005 −.0000

Built As
1.1004
1.1155

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−128	1
1	Sabot & Flyer Plate	LGG−157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long DATE 11/29/10
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

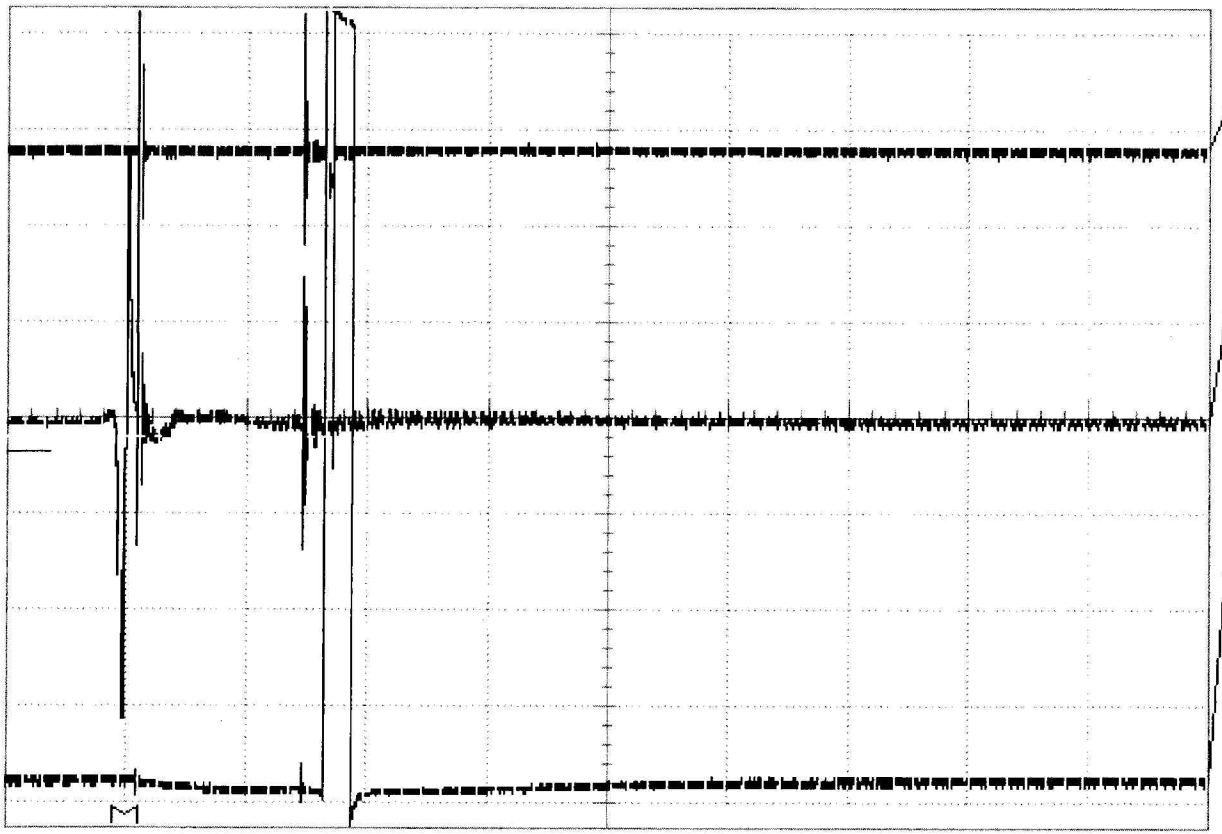
TITLE
Projectile Assy.
for 28mm launch tube (GM)

FINISH 16
MATERIAL Zelux−M&HDP
SCALE 2:1
SHEET 2 of 2
A
DRAWING NUMBER LGG−158

GS7

454_ Fo

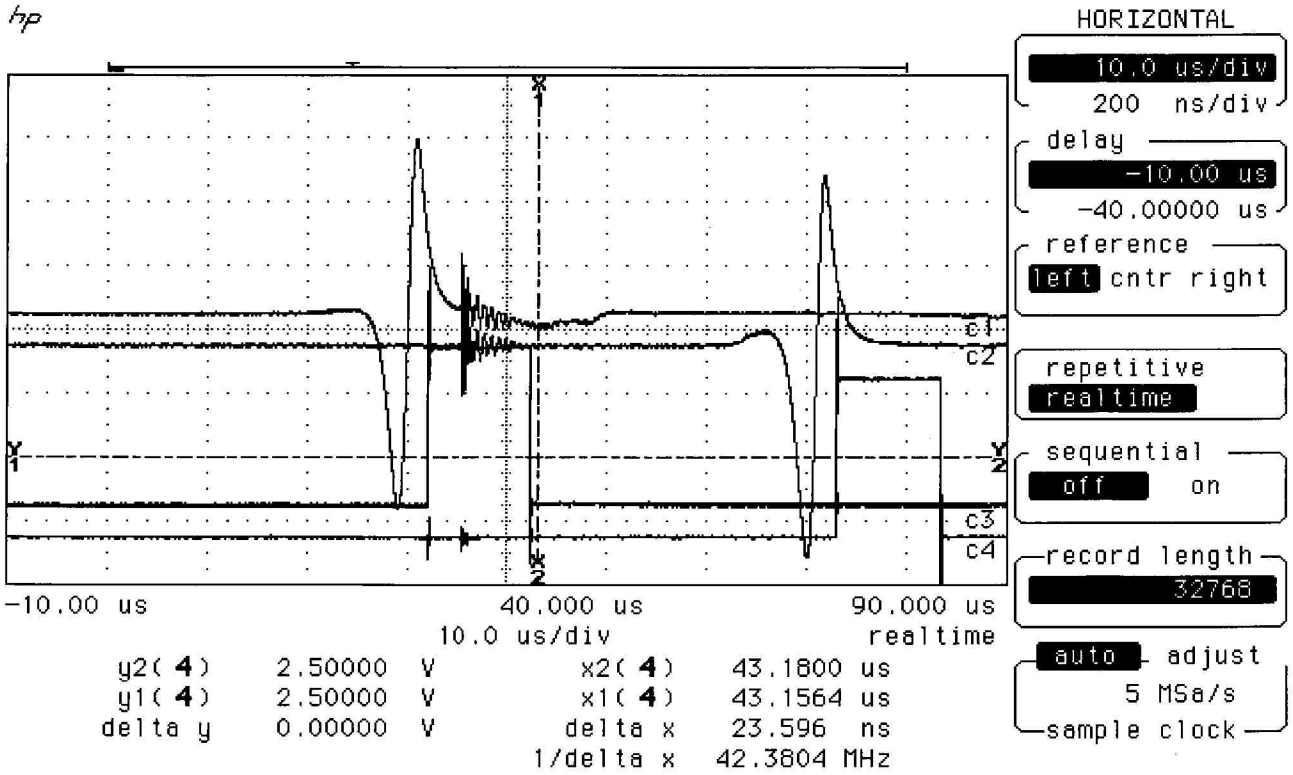
PRINTED : Apr-27-2012:16.27.34
PRODUCT : Classic 6500 S/N 84900024



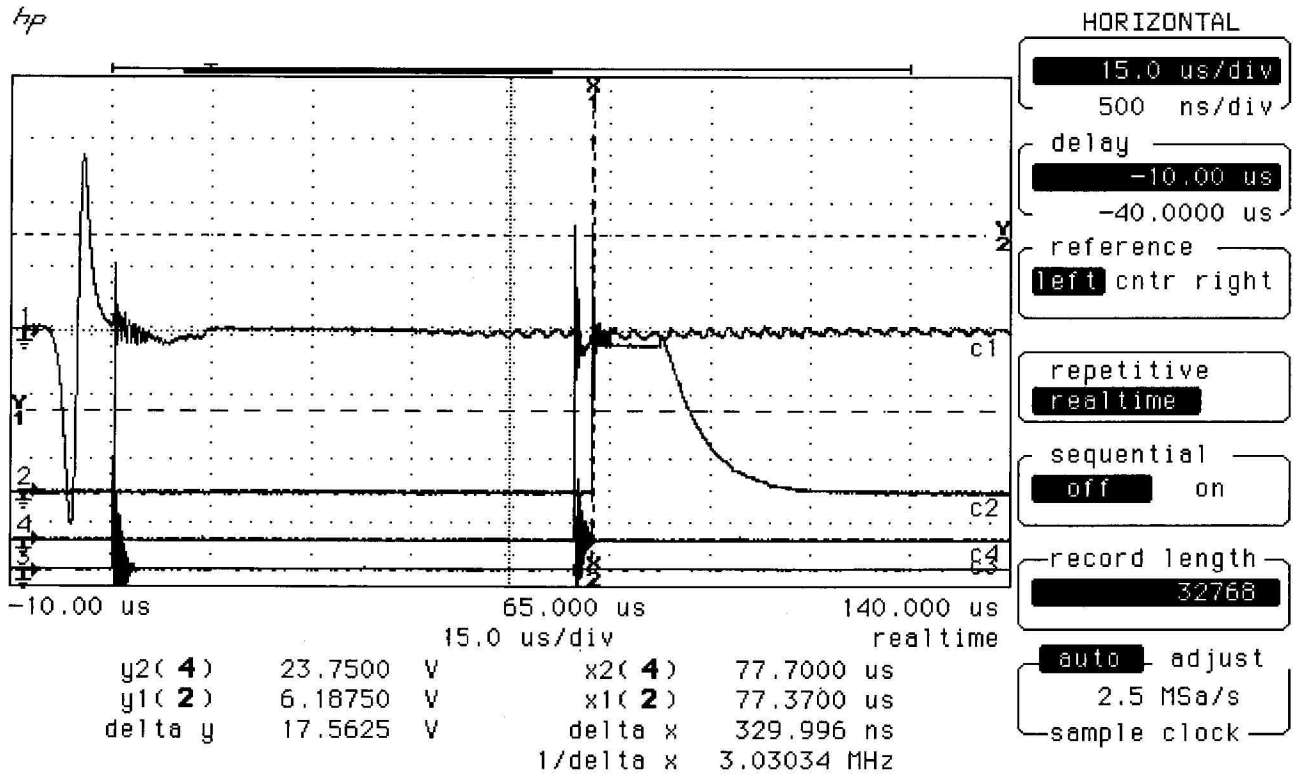
TRC4M:
(Apr-27-2012:15.48.14)
200mV/div,50µs/div
TRC1M:
(Apr-27-2012:15.48.14)
2V/div,50µs/div
TRC3M:
(Apr-27-2012:15.48.14)
5V/div,50µs/div

TR4M
CURSOR : TRC2 -9.24V
+133.9365µs
CURSOR : TRC1 -26.7mV
+74.75550µs
CURSOR : TRC3 Data over range
+74.75550µs
CURSOR : TRC4 Data over range
+74.75550µs

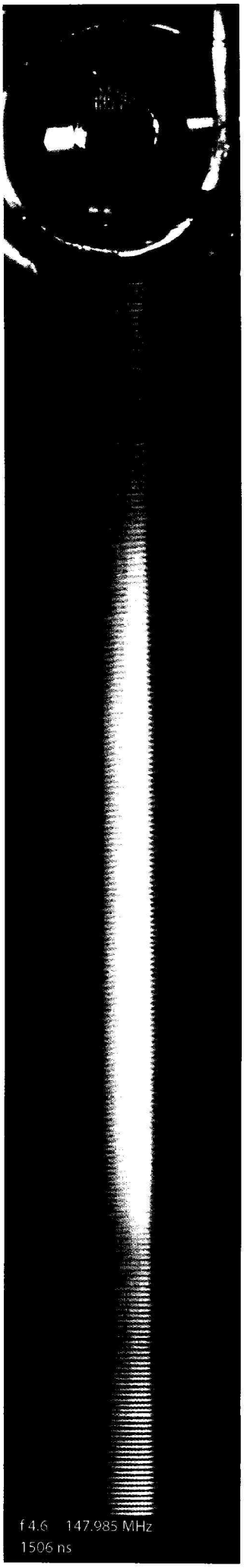
HP5 454


hp
HORIZONTAL
10.0 us/div
200 ns/div
delay
-10.00 us
-40.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
5 MSa/s
sample clock
c1
c2
c3
c4
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(4) 2.50000 V
y1(4) 2.50000 V
delta y 0.00000 V
x2(4) 43.1800 us
x1(4) 43.1564 us
delta x 23.596 ns
1/delta x 42.3804 MHz

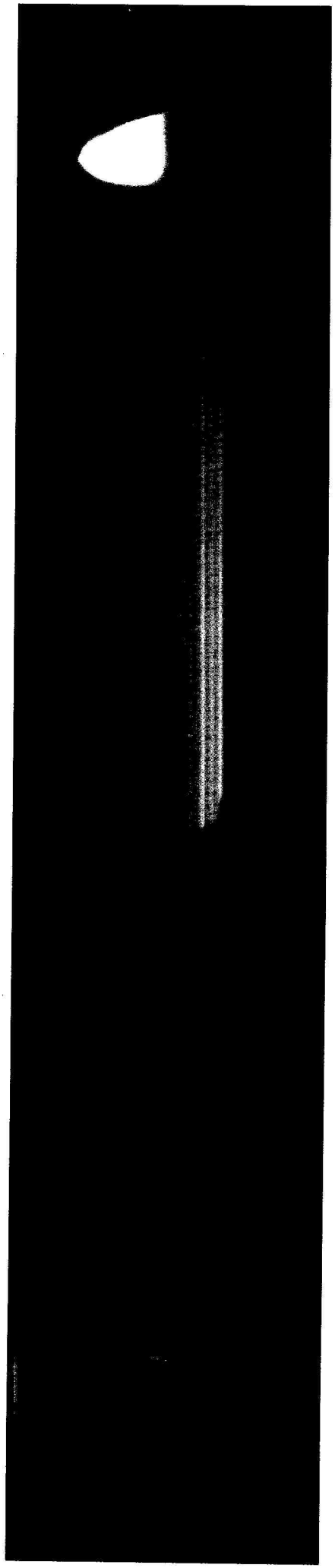
HP6 454


hp
HORIZONTAL
15.0 us/div
500 ns/div
delay
-10.00 us
-40.0000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
2.5 MSa/s
sample clock
c1
c2
c3
c4
-10.00 us
65.000 us
140.000 us
15.0 us/div
realtime
y2(4) 23.7500 V
y1(2) 6.18750 V
delta y 17.5625 V
x2(4) 77.7000 us
x1(2) 77.3700 us
delta x 329.996 ns
1/delta x 3.03034 MHz

Shot 454

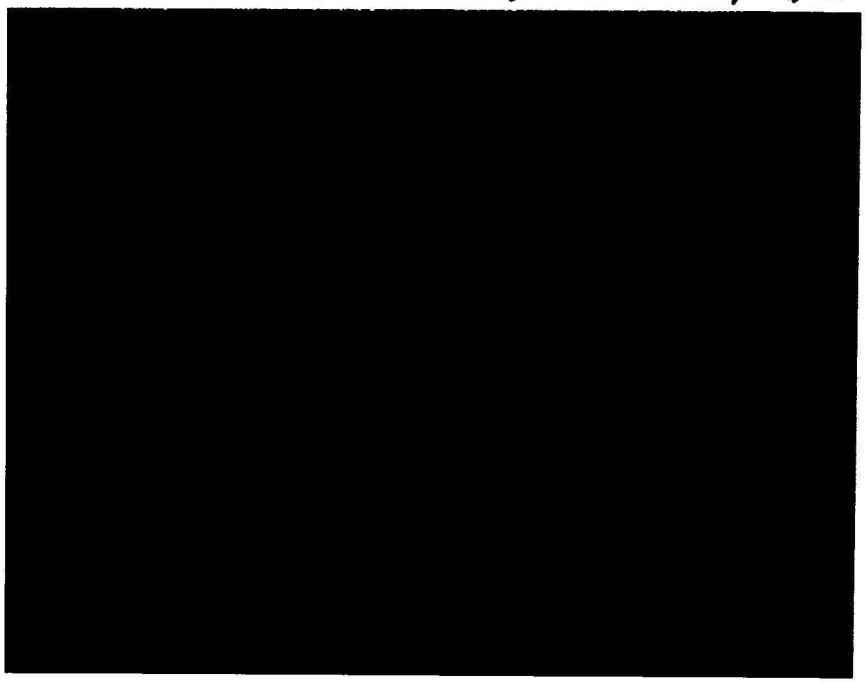


Shot 454



X-ray #2 shot 454 Fo 4/27/12

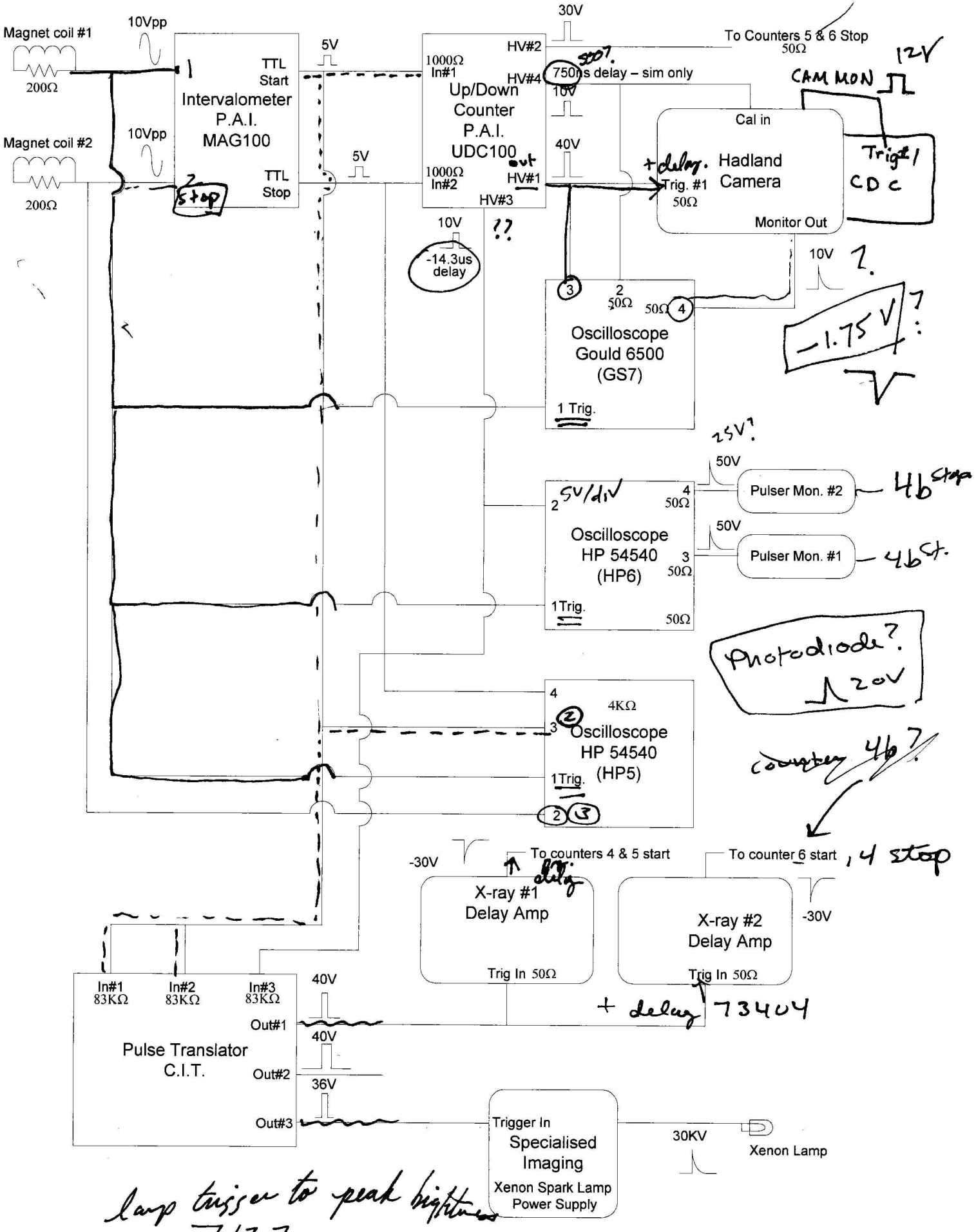
X-ray #1 454 forsterite 4/27/12



413

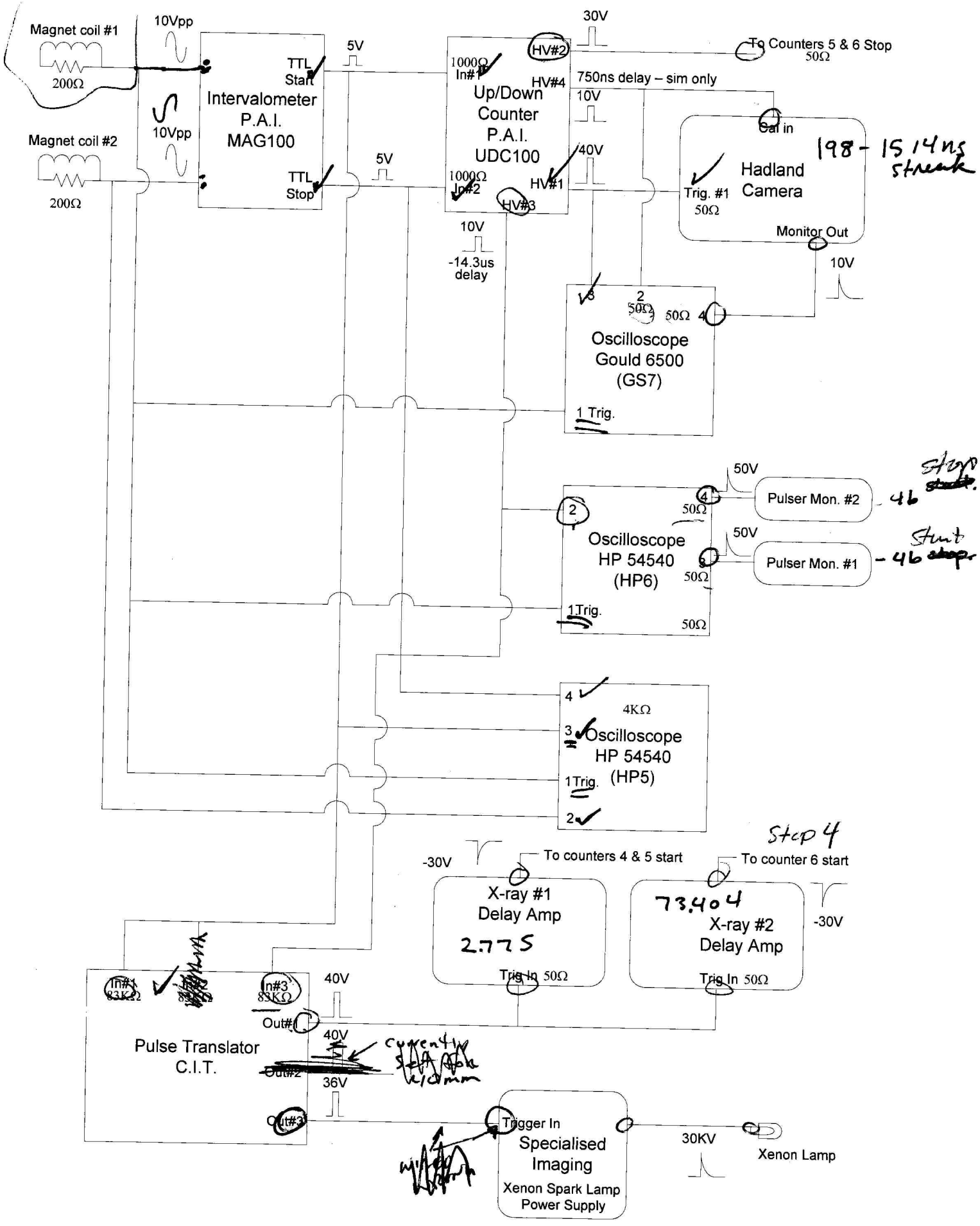
Shot #454 Scope Schematic

all scopes trig on Mag #1



lamp trigger to peak brightness 7127 ns.

Shot #454 Scope Schematic



LIGHT GAS GUN DATA SHEET

Shot No. 455 Date 5/9/12

Target:

Sample Material Forsterite (#27) Crystallographic orientation _____

Source Location Morion Created gems Thickness:1 _____ in.

Type of Measurement Pre-heated EOS 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std devs. _____ gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in. Material _____

Projectile:

Weight 20.204 gms. Length 0.9065 in. Skirt Diameter 1.1158 in.

Flyer Plate Material Mo Leading Edge Dia. 1.1004 in.

Thickness 0.06124 in. Major Dia. 0.9835 in. Depth Inserted 1" in.

Minor Dia. 0.927 in. Force: 175 lbs Temp 21°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.109 in.

Diameter: Front 3.499 in. Back 3.499 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 658 gms. Type IMR 4350 Total Charge 670 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 5.5 km/sec Piston _____ km/sec

Notes: - 5.422 km/s / 20000°C

- 2 gm low of gun powder on white balance!

- 0.5 gm " on digital

L.G.G.

Camera Streak Duration: 1506 nsec Timing calibration frequency: 149.87501 MHz

Camera Writing Rate Dial Value: _____

Camera Slit Size: 25 µm Target to film magnification 24 px/mm

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 2.243 µsec Flash X-ray #2 66.451 µsec

Static Streak Photo ~~15~~ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0546 in. min. 0.0927 in. min.

0.0571 in. max. 0.0929 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 100/110 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	466 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	936 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	37.600 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	65.778 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	72.027 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	6.254 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	65.811 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	37.550 µsec
UDC Velocity:			5422.92 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	67 ns
HP5, 2:	Velocity magnet 2	37.622 µsec
HP5, 3:	TTL Start	2.116 µsec ~~2.1159~~
HP5, 4:	TTL Stop	39.665 µsec
HP6, 1:	Velocity Magnet 1	54.2 ns
HP6,2:	Xenon Lamp Trigger	70.2378 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	~~70~~ 4.9452 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	70.7536 µsec
GS7, 1:	Velocity Magnet 1	−9.138 µsec
GS7,3:	Camera Trigger (UDC HV 1)	67.4025 µsec
GS7, 4:	Camera Monitor Out	67.6195 µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Mag Intervalometer ~~Counter 3:~~	Velocity Magnet #1	Velocity Magnet #2	37.406 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	64.106 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	71.659 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.558 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	64.116 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	37.360 µsec
UDC Velocity:			6449.54 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	303.20 ns
HP5, 2:	Velocity magnet 2	2.310 µsec
HP5, 3:	TTL Start	37.681 µsec
HP5, 4:	TTL Stop	39.674 µsec
HP6, 1:	Velocity Magnet 1	277.0 ns
HP6,2:	Xenon Lamp Trigger	70.064 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	5.187 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	69.302 µsec
GS7, 1:	Velocity Magnet 1	-8.984 µsec
GS7, 2:	Camera Cal. Sig.	67.817 µsec
GS7,3:	Camera Trigger (UDC HV 1)	67.137 µsec
GS7, 4:	Camera Monitor Out	67.352 µsec

Shot 455 Nominal Timeline Preshot

V	5500	
cable time	90	150
tervalometer intrinsic delay	[redacted]	
UDC extra count lag	[redacted]	
pulse translator delay	150	
X-ray 1 program delay	[redacted]	2243 X-ray 1 actual delay
X-ray 2 program delay	[redacted]	66451 X-ray 2 actual delay
X-ray 1 pulser delay	600	
X-ray 2 pulser delay	[redacted]	
Camera intrinsic delay	107	
› trigger to peak brightness	7127	
HV#3 delay to lamp	-6370	
Streak duration	1514	
d dead streak before driver	500	

	meters		
M1-M2 distance	0.203606	mag SIM time	37019 ns
M2-target distance	0.216789		
M2-target fudge	[redacted]		
M1-fid1 distance	0.03		
M1-fid2 distance	0.383145		
Flyer thickness	0.0015555		
Us(Mo)	8477.68656		
driver thickness	0.00100584		
cap thickness	0.00078207		
estimated sample+cover time	200.077366		

	rho0	Co	s	
Cold Mo	10206	5033	1.28946405	
Hot Mo	9785	4857.9	1.2875	2000 C
Liquid Forsterit	2653.62	3772.0	1.431415	

				up	P	Us
driver	562.0825943	-243664321	6.80616E+11	2811.48471	233.224361	**8477.68656**
sample	8799.754822	-199222390	6.65612E+11	4074.26519	103.833522	**9603.93967**
cap	-8799.75482	-119447232	3.33772E+11	2377.78387	184.25523	**7919.29674**

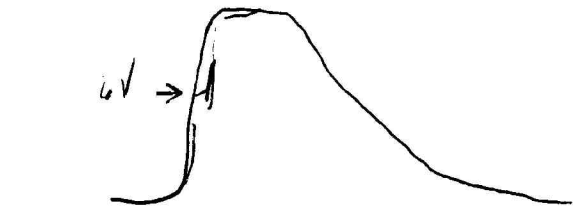
t (ns)	flyer x (m)	shock front (m)	event
0	0.00077775		M1 zero-crossing
150	0.00160275		HP5-1, GS7-1, HP6-1, Intervalometer start
2230	0.01304275		HP5-3, UDC start, signal to pulse translator
2380	0.01386775		pulse translator out
4623	0.02620425		X-ray 1 delay amp out to counters 4, 5
5313	0.02999925		X-ray 1 fires
5403	0.03049425		X-ray 1 pulse monitor at counter 4b
37019	0.20438375		M2 zero-crossing
37169	0.20520875		HP5-2, Intervalometer stop
39249	0.21664875		HP5-4, UDC stop
68831	0.37934825		X-ray 2 delay amp, stop counter 4, start counter 6
69546	0.38328075		X-ray 2 fires
69636	0.38377575		X-ray 2 pulse monitor at counter 4b
75716	0.41721405		UDC out, GS7-3, stop counters 5 and 6
75806	0.41770905		Trigger at camera
75913	0.41829755		Begin Streak
76003	0.41879255		Camera Monitor on GS7-4
76294	0.420395	0	IMPACT
76413		0.00100584	Driver arrival on streak
76613		0.002702033	Sample cutoff on streak
77427		0.009602214	End Streak

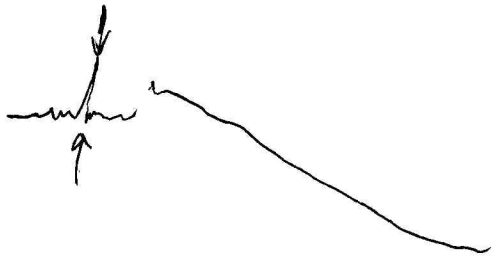
			X-ray velocity	5500
				On film
		X-ray 1 flyer vs. fid (mm)	-0.000752	-0.0008744
Counter 3:	37019			
		HP5 2-1		37019
UDC upcount:	37019	HP5 4-3		37019
Counter 4:	64208			
		X-ray 2 flyer vs. fid (mm)	0.135748	0.15784651
Counter 4b:	64233			
Counter 5:	71093	GS7 3-1		75566
Counter 6:	6885	GS7 4-1		75853
		HP6-1		

		scopes		
triq		GS7-1	0 10V pp	rising
sim only		GS7-2	76216 10 V _-_	ttl
		GS7-3	• 75566 40 V _-_	
		GS7-4	• 75853 (-)1.75 V	down going
triq		HP5-1	0 10V pp	rising
		HP5-2	37019 10V pp	rising
		HP5-3	2080 5 V _-_	
		HP5-4	39099 5 V _-_	
triq		HP6-1	0 10V pp	rising
HV#1-14.3us (		HP6-2	61416 10 V _-_	
		HP6-3	• 5253 25 V /\	
		HP6-4	69486 25 V /\	

Driver cutoff on streak	500
Sample cutoff on sreak	700

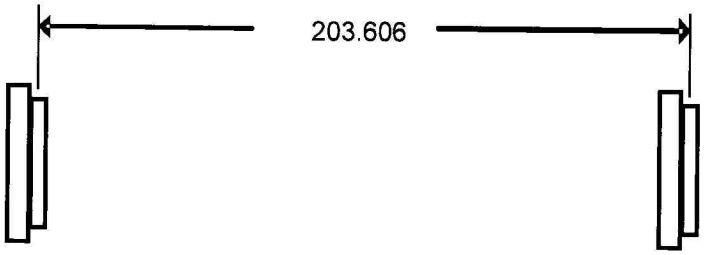
lamp?





MAGNET DISTANCE

Shot No. **455** Expected Velocity: **5.50**



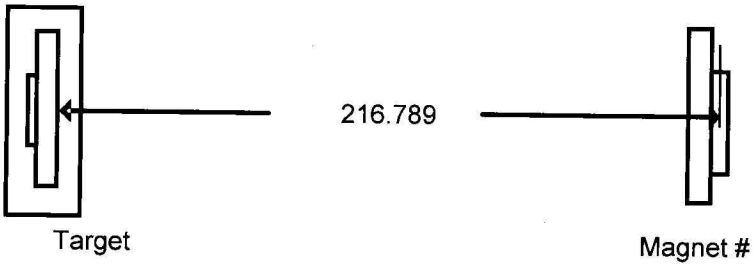
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm ✓

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **37.019 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.412 inch

Second measurement = 8.409 inch

Average measurement = 8.410 inch

Average measurement = 213.614 mm ✓

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 216.789 mm

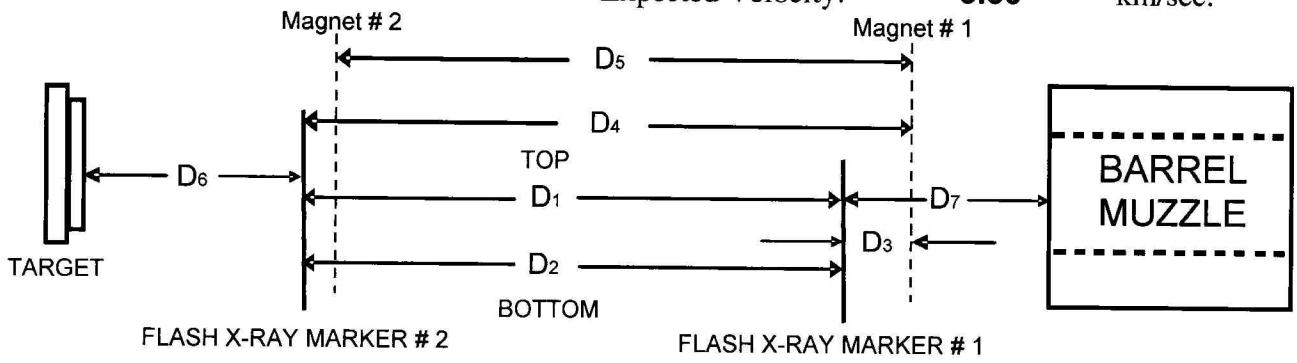
TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **39.416 µsec.**

Fudged Distance between Magnet 2 to Target = 0 mm ~~0.199907~~ meters

0.199889

TARGET MEASUREMENT

Shot No. **455** Expected Velocity: **5.50** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	34.0	99.0
Measure # 2, mm	30.00	383.15	203.66	35.0	99.0
Average, mm	30.00	383.15	203.61	34.5	99.0
Travel time, µsec	**5.45**	**69.66**	**37.02**	**6.27**	**18.00**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **64.22** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

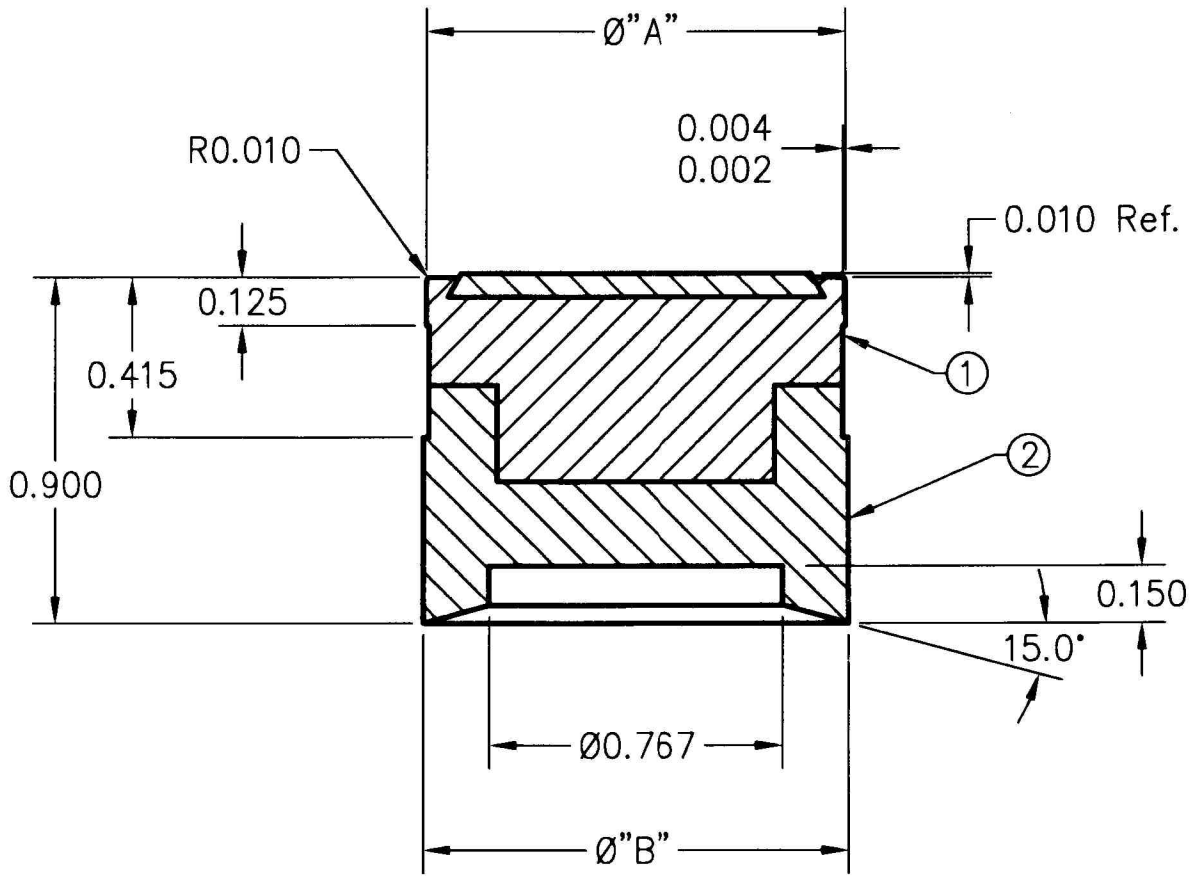
Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **64.20** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **2.35** µsec. 2.243

Flash X-Ray # 2 Delay (from Magnet # 1) **67.01** µsec. 66.451

FLYER #3(Mo)
PRESSED: 2/29/12
~~BUILT~~



Note: Super Glue & Press Fit 1 & 2

BUILT AS	SHOT#		
1.1004	A	1.1004	+.0000 −.0005
1.1162	B	1.1158	+.0005 −.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−128	1
1	Sabot & Flyer Plate	LGG−157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN	DATE
M. Long	11/29/10
ENGINEER	DATE
APPROVED	DATE

MATERIAL: Zelux−M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy. for 28mm launch tube (GM)

SCALE	SHEET		DRAWING NUMBER
2:1	2 of 2	A	LGG−158

SHOT No. ___455_____ tip used: .7mm long/ flat tip

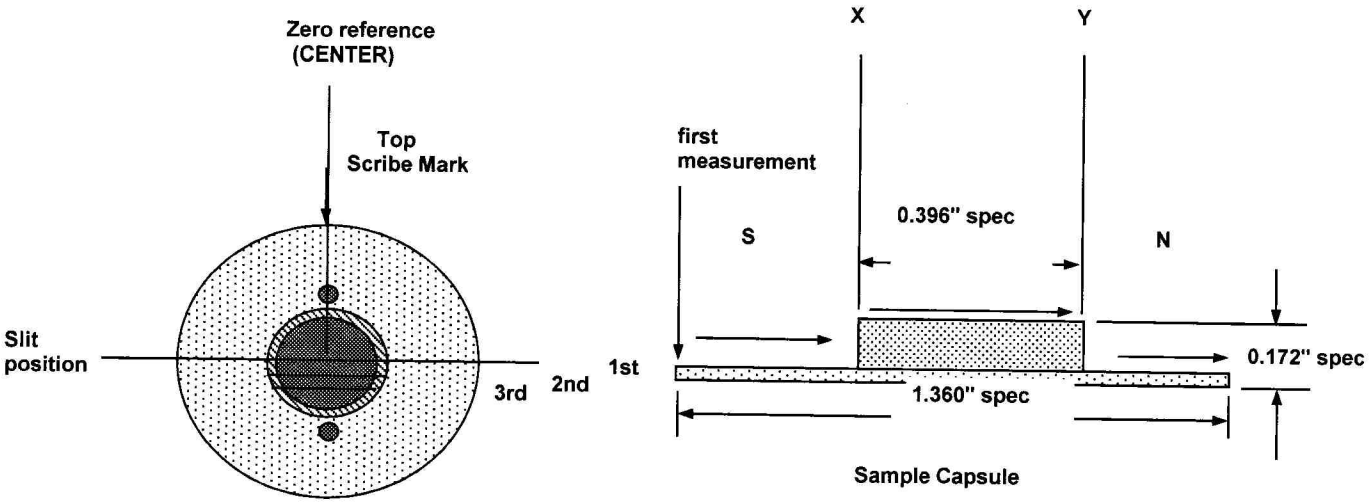
SAMPLE CAPSULE: 27 note: the platform on which the measurement was taken

SAMPLE MATERIAL: deviates from flat by +0.013 max.

direction of measurement

4.849

THICKNESS PROFILE (Not re-polished, but final surface) 1.792



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00151

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00000

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

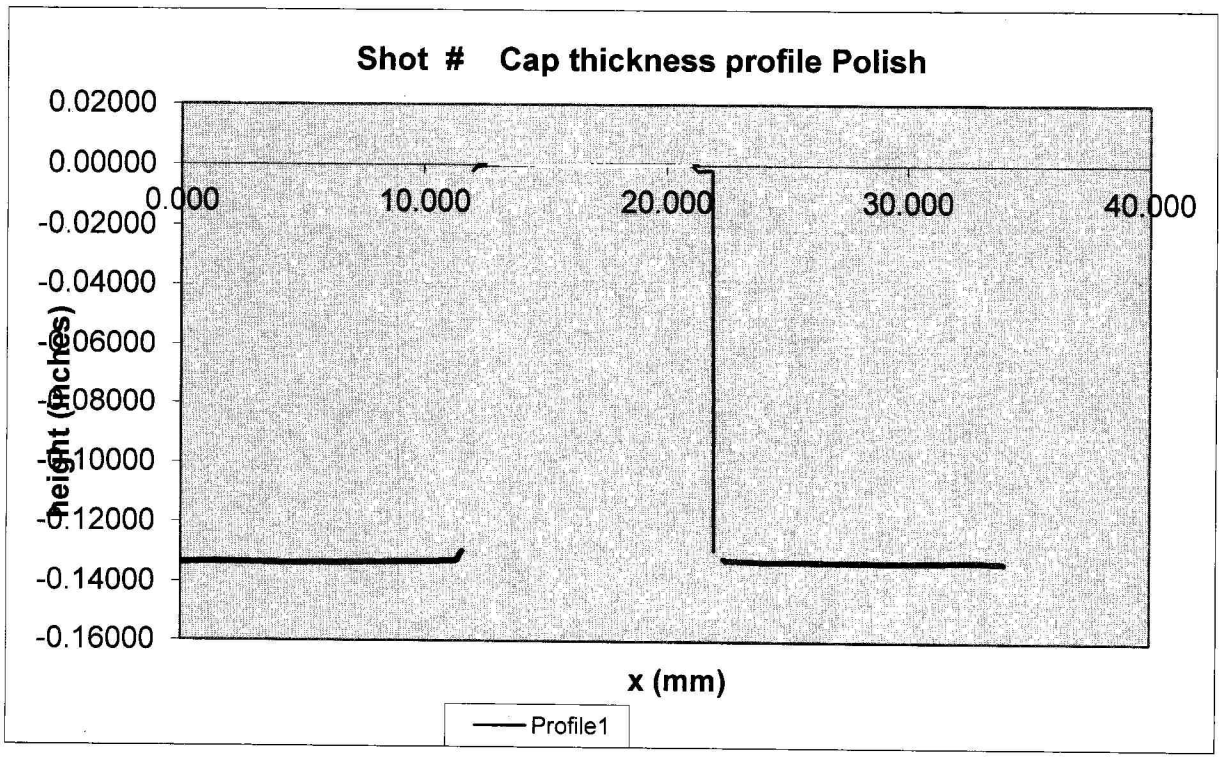
Average thickness reading = 0.00000

Note: Measurement from reference zero point from the base is = **0.1728** Inches
4.3891 mm

Average thickness of the driver Plate = 0.0396 Inches
1.0047 mm

Thickness of the Carbon Deposited on the coil side is = 48.70 nm

Thickness of the C Deposited on the Projectile side is = 50.20 nm


Shot # Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
-0.16000
0.000
10.000
20.000
30.000
40.000
Height (inches)
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Below the center with 0.100 MM i
3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s	# reading	dist(mm)
1	0.000	17.000	-0.1340	225	22.400	-5.400	-0.1321	118	11.700
2	0.100	16.900	-0.1338	226	22.500	-5.500	-0.1328	119	11.800
3	0.200	16.800	-0.1338	227	22.600	-5.600	-0.1327	120	11.900
4	0.300	16.700	-0.1337	228	22.700	-5.700	-0.1327	121	12.000
5	0.400	16.600	-0.1337	229	22.800	-5.800	-0.1328	122	12.100
6	0.500	16.500	-0.1337	230	22.900	-5.900	-0.1327	123	12.200
7	0.600	16.400	-0.1336	231	23.000	-6.000	-0.1328	124	12.300
8	0.700	16.300	-0.1336	232	23.100	-6.100	-0.1328	125	12.400
9	0.800	16.200	-0.1336	233	23.200	-6.200	-0.1328	126	12.500
10	0.900	16.100	-0.1335	234	23.300	-6.300	-0.1328	127	12.600
11	1.000	16.000	-0.1335	235	23.400	-6.400	-0.1329	128	12.700
12	1.100	15.900	-0.1335	236	23.500	-6.500	-0.1329	129	12.800
13	1.200	15.800	-0.1335	237	23.600	-6.600	-0.1329	130	12.900
14	1.300	15.700	-0.1335	238	23.700	-6.700	-0.1330	131	13.000
15	1.400	15.600	-0.1335	239	23.800	-6.800	-0.1330	132	13.100
16	1.500	15.500	-0.1335	240	23.900	-6.900	-0.1331	133	13.200
17	1.600	15.400	-0.1335	241	24.000	-7.000	-0.1331	134	13.300
18	1.700	15.300	-0.1335	242	24.100	-7.100	-0.1331	135	13.400
19	1.800	15.200	-0.1335	243	24.200	-7.200	-0.1331	136	13.500
20	1.900	15.100	-0.1335	244	24.300	-7.300	-0.1331	137	13.600
21	2.000	15.000	-0.1335	245	24.400	-7.400	-0.1331	138	13.700
22	2.100	14.900	-0.1335	246	24.500	-7.500	-0.1331	139	13.800
23	2.200	14.800	-0.1335	247	24.600	-7.600	-0.1331	140	13.900
24	2.300	14.700	-0.1335	248	24.700	-7.700	-0.1331	141	14.000
25	2.400	14.600	-0.1336	249	24.800	-7.800	-0.1331	142	14.100
26	2.500	14.500	-0.1336	250	24.900	-7.900	-0.1331	143	14.200
27	2.600	14.400	-0.1336	251	25.000	-8.000	-0.1331	144	14.300
28	2.700	14.300	-0.1336	252	25.100	-8.100	-0.1331	145	14.400
29	2.800	14.200	-0.1336	253	25.200	-8.200	-0.1331	146	14.500
30	2.900	14.100	-0.1336	254	25.300	-8.300	-0.1331	147	14.600
31	3.000	14.000	-0.1336	255	25.400	-8.400	-0.1331	148	14.700
32	3.100	13.900	-0.1336	256	25.500	-8.500	-0.1331	149	14.800
33	3.200	13.800	-0.1336	257	25.600	-8.600	-0.1332	150	14.900
34	3.300	13.700	-0.1337	258	25.700	-8.700	-0.1332	151	15.000
35	3.400	13.600	-0.1337	259	25.800	-8.800	-0.1332	152	15.100
36	3.500	13.500	-0.1337	260	25.900	-8.900	-0.1332	153	15.200
37	3.600	13.400	-0.1337	261	26.000	-9.000	-0.1332	154	15.300
38	3.700	13.300	-0.1337	262	26.100	-9.100	-0.1332	155	15.400
39	3.800	13.200	-0.1337	263	26.200	-9.200	-0.1332	156	15.500
40	3.900	13.100	-0.1337	264	26.300	-9.300	-0.1332	157	15.600
41	4.000	13.000	-0.1337	265	26.400	-9.400	-0.1332	158	15.700
42	4.100	12.900	-0.1337	266	26.500	-9.500	-0.1332	159	15.800
43	4.200	12.800	-0.1337	267	26.600	-9.600	-0.1332	160	15.900
44	4.300	12.700	-0.1337	268	26.700	-9.700	-0.1332	161	16.000
45	4.400	12.600	-0.1337	269	26.800	-9.800	-0.1332	162	16.100
46	4.500	12.500	-0.1337	270	26.900	-9.900	-0.1332	163	16.200
47	4.600	12.400	-0.1337	271	27.000	-10.000	-0.1332	164	16.300
48	4.700	12.300	-0.1337	272	27.100	-10.100	-0.1332	165	16.400
49	4.800	12.200	-0.1338	273	27.200	-10.200	-0.1332	166	16.500
50	4.900	12.100	-0.1337	274	27.300	-10.300	-0.1332	167	16.600
51	5.000	12.000	-0.1337	275	27.400	-10.400	-0.1332	168	16.700
52	5.100	11.900	-0.1337	276	27.500	-10.500	-0.1332	169	16.800
53	5.200	11.800	-0.1337	277	27.600	-10.600	-0.1332	170	16.900
54	5.300	11.700	-0.1337	278	27.700	-10.700	-0.1333	171	17.000
55	5.400	11.600	-0.1337	279	27.800	-10.800	-0.1333	172	17.100
56	5.500	11.500	-0.1337	280	27.900	-10.900	-0.1333	173	17.200
57	5.600	11.400	-0.1337	281	28.000	-11.000	-0.1333	174	17.300

58	5.700	11.300	-0.1337	282	28.100	-11.100	-0.1333	175	17.400
59	5.800	11.200	-0.1337	283	28.200	-11.200	-0.1333	176	17.500
60	5.900	11.100	-0.1337	284	28.300	-11.300	-0.1332	177	17.600
61	6.000	11.000	-0.1337	285	28.400	-11.400	-0.1332	178	17.700
62	6.100	10.900	-0.1336	286	28.500	-11.500	-0.1332	179	17.800
63	6.200	10.800	-0.1336	287	28.600	-11.600	-0.1333	180	17.900
64	6.300	10.700	-0.1336	288	28.700	-11.700	-0.1333	181	18.000
65	6.400	10.600	-0.1336	289	28.800	-11.800	-0.1332	182	18.100
66	6.500	10.500	-0.1336	290	28.900	-11.900	-0.1333	183	18.200
67	6.600	10.400	-0.1336	291	29.000	-12.000	-0.1333	184	18.300
68	6.700	10.300	-0.1336	292	29.100	-12.100	-0.1333	185	18.400
69	6.800	10.200	-0.1336	293	29.200	-12.200	-0.1333	186	18.500
70	6.900	10.100	-0.1336	294	29.300	-12.300	-0.1333	187	18.600
71	7.000	10.000	-0.1335	295	29.400	-12.400	-0.1333	188	18.700
72	7.100	9.900	-0.1336	296	29.500	-12.500	-0.1333	189	18.800
73	7.200	9.800	-0.1335	297	29.600	-12.600	-0.1332	190	18.900
74	7.300	9.700	-0.1335	298	29.700	-12.700	-0.1332	191	19.000
75	7.400	9.600	-0.1335	299	29.800	-12.800	-0.1332	192	19.100
76	7.500	9.500	-0.1335	300	29.900	-12.900	-0.1333	193	19.200
77	7.600	9.400	-0.1335	301	30.000	-13.000	-0.1332	194	19.300
78	7.700	9.300	-0.1335	302	30.100	-13.100	-0.1332	195	19.400
79	7.800	9.200	-0.1335	303	30.200	-13.200	-0.1332	196	19.500
80	7.900	9.100	-0.1335	304	30.300	-13.300	-0.1332	197	19.600
81	8.000	9.000	-0.1335	305	30.400	-13.400	-0.1332	198	19.700
82	8.100	8.900	-0.1334	306	30.500	-13.500	-0.1332	199	19.800
83	8.200	8.800	-0.1334	307	30.600	-13.600	-0.1332	200	19.900
84	8.300	8.700	-0.1334	308	30.700	-13.700	-0.1332	201	20.000
85	8.400	8.600	-0.1334	309	30.800	-13.800	-0.1331	202	20.100
86	8.500	8.500	-0.1334	310	30.900	-13.900	-0.1331	203	20.200
87	8.600	8.400	-0.1334	311	31.000	-14.000	-0.1331	204	20.300
88	8.700	8.300	-0.1334	312	31.100	-14.100	-0.1331	205	20.400
89	8.800	8.200	-0.1334	313	31.200	-14.200	-0.1331	206	20.500
90	8.900	8.100	-0.1334	314	31.300	-14.300	-0.1331	207	20.600
91	9.000	8.000	-0.1333	315	31.400	-14.400	-0.1331	208	20.700
92	9.100	7.900	-0.1333	316	31.500	-14.500	-0.1331	209	20.800
93	9.200	7.800	-0.1333	317	31.600	-14.600	-0.1330	210	20.900
94	9.300	7.700	-0.1333	318	31.700	-14.700	-0.1330	211	21.000
95	9.400	7.600	-0.1332	319	31.800	-14.800	-0.1330	212	21.100
96	9.500	7.500	-0.1332	320	31.900	-14.900	-0.1330	213	21.200
97	9.600	7.400	-0.1332	321	32.000	-15.000	-0.1330	214	21.300
98	9.700	7.300	-0.1332	322	32.100	-15.100	-0.1330	215	21.400
99	9.800	7.200	-0.1333	323	32.200	-15.200	-0.1329	216	21.500
100	9.900	7.100	-0.1332	324	32.300	-15.300	-0.1329	217	21.600
101	10.000	7.000	-0.1333	325	32.400	-15.400	-0.1329	218	21.700
102	10.100	6.900	-0.1332	326	32.500	-15.500	-0.1329	219	21.800
103	10.200	6.800	-0.1332	327	32.600	-15.600	-0.1329	220	21.900
104	10.300	6.700	-0.1333	328	32.700	-15.700	-0.1329	221	22.000
105	10.400	6.600	-0.1332	329	32.800	-15.800	-0.1329	222	22.100
106	10.500	6.500	-0.1331	330	32.900	-15.900	-0.1329	223	22.200
107	10.600	6.400	-0.1331	331	33.000	-16.000	-0.1329	224	22.300
108	10.700	6.300	-0.1330	332	33.100	-16.100	-0.1329		
109	10.800	6.200	-0.1330	333	33.200	-16.200	-0.1330		
110	10.900	6.100	-0.1330	334	33.300	-16.300	-0.1330		
111	11.000	6.000	-0.1329	335	33.400	-16.400	-0.1330		
112	11.100	5.900	-0.1329	336	33.500	-16.500	-0.1331		
113	11.200	5.800	-0.1329	337	33.600	-16.600	-0.1331		
114	11.300	5.700	-0.1329	338	33.700	-16.700	-0.1332		
115	11.400	5.600	-0.1327	339	33.800	-16.800	-0.1332		
116	11.500	5.500	-0.1309	340	33.900	-16.900	-0.1332		
117	11.600	5.400	-0.1297	341	34.000	-17.000	-0.1333		

ncrement

absdist(mm	1st	2nd	3 rd
5.300	Run	Run	Run
5.200	Reading	Reading	Reading
5.100	Inches	Inches	Inches
5.000			
4.900			
4.800			
4.700	-0.00230		
4.600	-0.00125		
4.500	-0.00070	0.00000	
4.400	-0.00060	0.00000	
4.300	-0.00035	0.00000	
4.200	-0.00030	0.00000	
4.100	-0.00025	0.00000	0.00000
4.000	-0.00020	0.00000	0.00000
3.900	-0.00020	0.00000	0.00000
3.800	-0.00020	0.00000	0.00000
3.700	-0.00020	0.00000	0.00000
3.600	-0.00015	0.00000	0.00000
3.500	-0.00015	0.00000	0.00000
3.400	-0.00010	0.00000	0.00000
3.300	-0.00010	0.00000	0.00000
3.200	-0.00010	0.00000	0.00000
3.100	-0.00010	0.00000	0.00000
3.000	-0.00010	0.00000	0.00000
2.900	-0.00010	0.00000	0.00000
2.800	-0.00010	0.00000	0.00000
2.700	-0.00010	0.00000	0.00000
2.600	-0.00010	0.00000	0.00000
2.500	-0.00010	0.00000	0.00000
2.400	-0.00005	0.00000	0.00000
2.300	-0.00010	0.00000	0.00000
2.200	-0.00010	0.00000	0.00000
2.100	-0.00005	0.00000	0.00000
2.000	-0.00005	0.00000	0.00000
1.900	-0.00005	0.00000	0.00000
1.800	-0.00005	0.00000	0.00000
1.700	-0.00005	0.00000	0.00000
1.600	-0.00005	0.00000	0.00000
1.500	-0.00005	0.00000	0.00000
1.400	-0.00005	0.00000	0.00000
1.300	-0.00010	0.00000	0.00000
1.200	-0.00005	0.00000	0.00000
1.100	-0.00005	0.00000	0.00000
1.000	-0.00005	0.00000	0.00000
0.900	-0.00005	0.00000	0.00000
0.800	-0.00005	0.00000	0.00000
0.700	0.00000	0.00000	0.00000
0.600	0.00000	0.00000	0.00000
0.500	0.00000	0.00000	0.00000
0.400	0.00000	0.00000	0.00000
0.300	-0.00005	0.00000	0.00000
0.200	0.00000	0.00000	0.00000
0.100	-0.00005	0.00000	0.00000
0.000	0.00000	0.00000	0.00000
-0.100	0.00000	0.00000	0.00000
-0.200	0.00005	0.00000	0.00000
-0.300	0.00000	0.00000	0.00000

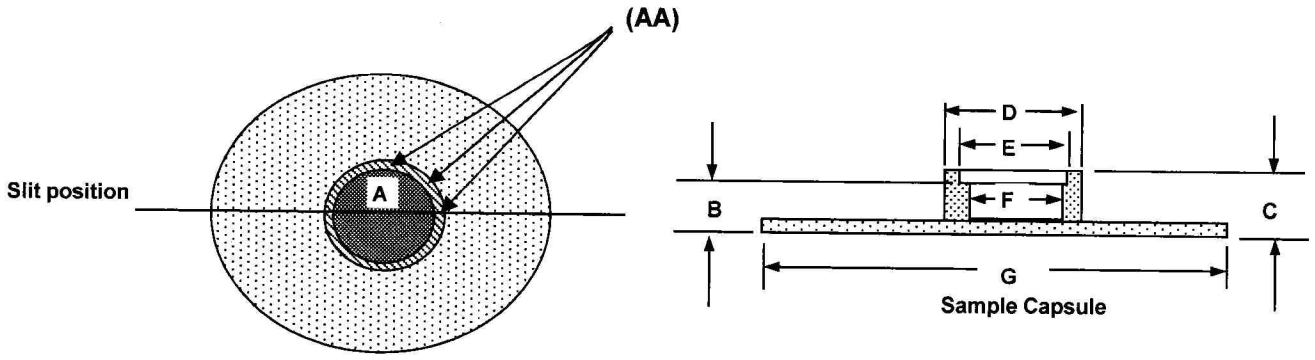
-0.400	0.00005	0.00000	0.00000
-0.500	0.00005	0.00000	0.00000
-0.600	0.00005	0.00000	0.00000
-0.700	0.00000	0.00000	0.00000
-0.800	0.00005	0.00000	0.00000
-0.900	0.00005	0.00000	0.00000
-1.000	0.00005	0.00000	0.00000
-1.100	0.00005	0.00000	0.00000
-1.200	0.00005	0.00000	0.00000
-1.300	0.00005	0.00000	0.00000
-1.400	0.00005	0.00000	0.00000
-1.500	0.00005	0.00000	0.00000
-1.600	0.00005	0.00000	0.00000
-1.700	0.00005	0.00000	0.00000
-1.800	0.00005	0.00000	0.00000
-1.900	0.00005	0.00000	0.00000
-2.000	0.00005	0.00000	0.00000
-2.100	0.00005	0.00000	0.00000
-2.200	0.00010	0.00000	0.00000
-2.300	0.00010	0.00000	0.00000
-2.400	0.00005	0.00000	0.00000
-2.500	0.00005	0.00000	0.00000
-2.600	0.00005	0.00000	0.00000
-2.700	0.00010	0.00000	0.00000
-2.800	0.00005	0.00000	0.00000
-2.900	0.00010	0.00000	0.00000
-3.000	0.00010	0.00000	0.00000
-3.100	0.00010	0.00000	0.00000
-3.200	0.00005	0.00000	0.00000
-3.300	0.00005	0.00000	0.00000
-3.400	0.00005	0.00000	0.00000
-3.500	0.00005	0.00000	0.00000
-3.600	0.00005	0.00000	0.00000
-3.700	0.00000	0.00000	0.00000
-3.800	0.00005	0.00000	0.00000
-3.900	0.00000	0.00000	0.00000
-4.000	0.00000	0.00000	0.00000
-4.100	0.00000	0.00000	0.00000
-4.200	-0.00010	0.00000	0.00000
-4.300	-0.00010	0.00000	0.00000
-4.400	-0.00045	0.00000	
-4.500	-0.00150	0.00000	
-4.600	-0.00215	0.00000	
-4.700	-0.00210		
-4.800	-0.00200		
-4.900	-0.00180		
-5.000	-0.00180		
-5.100	-0.00180		
-5.200	-0.00210		
-5.300	-0.12930		

SHOT No.: 455 prepolish 11/18/2010

SAMPLE CAPSULE: 27

SAMPLE MATERIAL: Molybdenum

Cap(see attached sheet)



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04100
A	0.04095
A	0.04090
A	0.04095
Avg	0.04095

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3535
F	0.3140
F	0.3145

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17095
C	0.17110
C	0.17100
C	0.17105
D	0.3960
D	0.3960
G	1.3595
G	1.3595
H	0.10114

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14180
B point 2	0.14225
B point 3	0.14245
B point 4	0.14225
B point 5	0.14215
B point 6	0.14185
B point 7	0.14200
B point 8	0.14200

Statistics

N	8
MAX	0.14245
MIN	0.14180
Range	0.00065
Average	0.14209

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

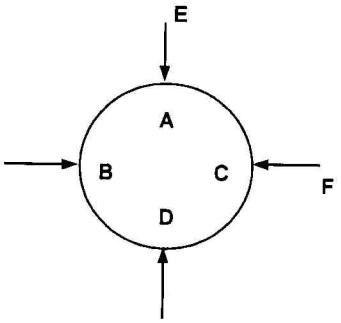
SHOT No. _ 455
LGG Moly Capsule Cap
SAMPLE MATERIAL: Mo 27

11/18/2010

Post polish

Thickness Measurement

A	0.03075
A	0.03085
B	0.03070
B	0.03070
C	0.03085
C	0.03085
D	0.03085
D	0.03080



Diameter Measurement

E	0.35350
E	0.35350
F	0.35400
F	0.35400
AVE	0.35375
Radius	0.1769

Statistic for thickness

N	8
MAX	0.03085
MIN	0.0307
Range	0.00015
MEAN	0.03079
STDEV	6.78101E-05

Statistic for perimeter

N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.35375
STDEV	0.000288675

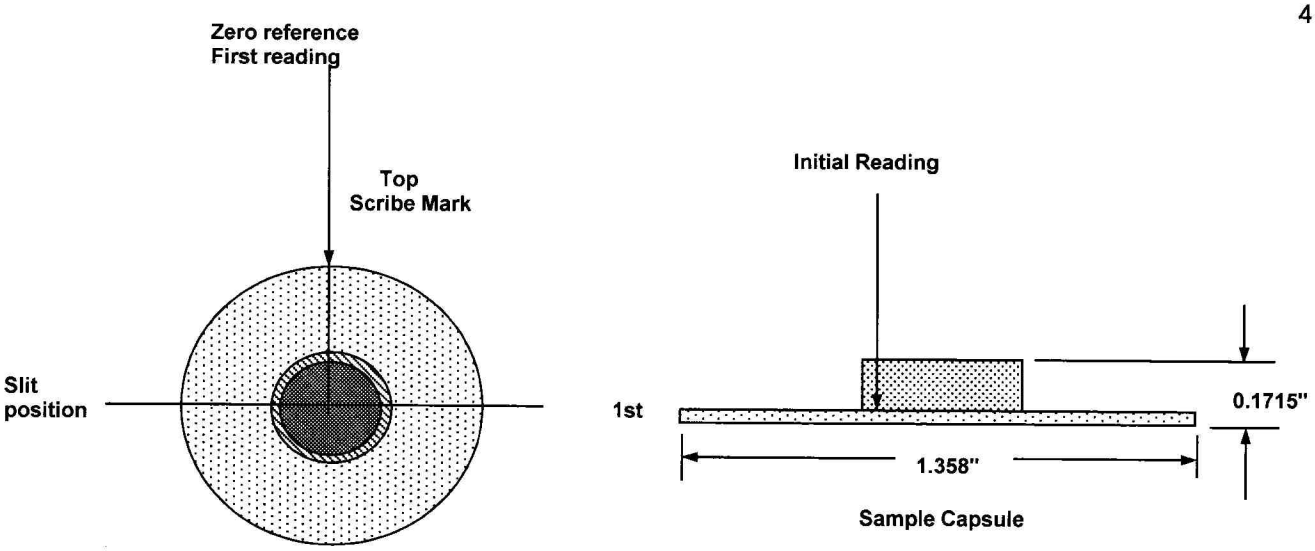
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03079375	±	mm	
	FLATNESS:		0.00015			
	VOLUME:		0.0496		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.0263		$grams/cm^3$	

SAMPLE CAPSULE: **27**
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

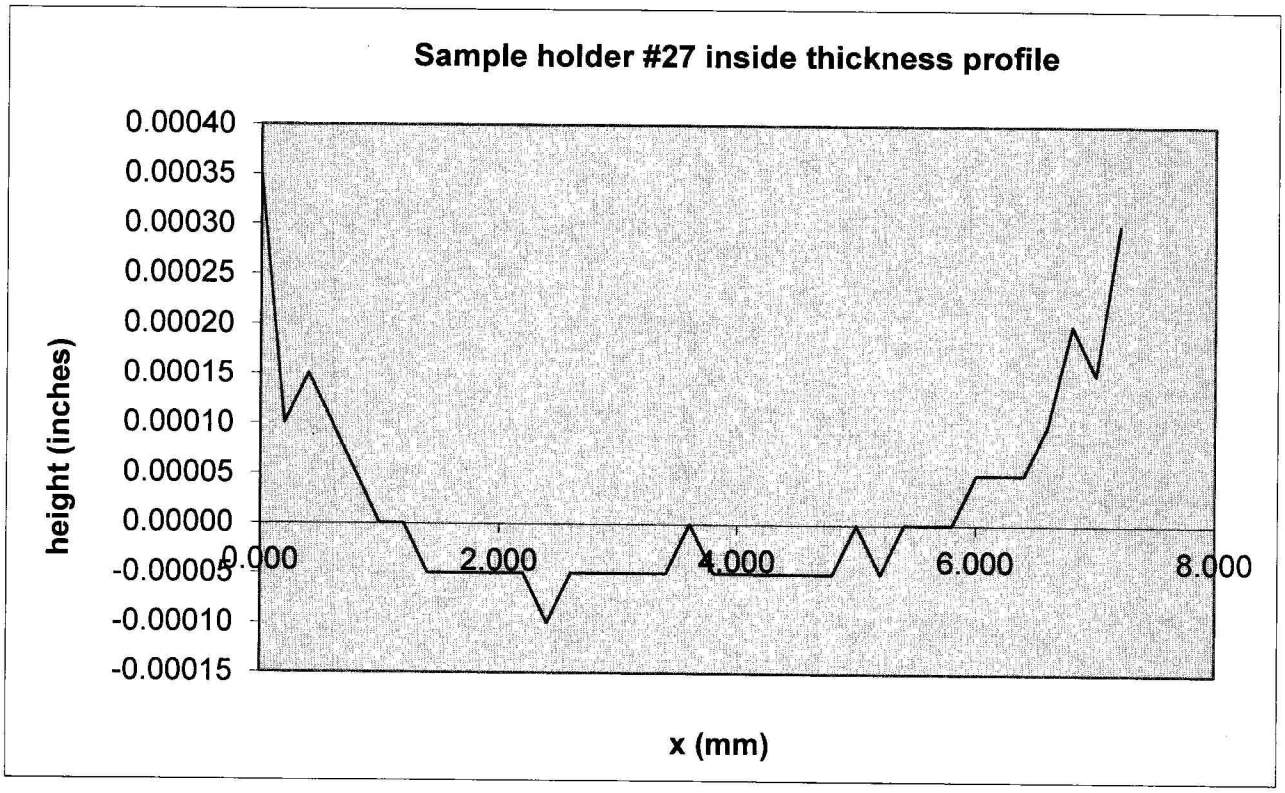
1.855
4.623



1.338582677

Average thickness reading = 0.00002

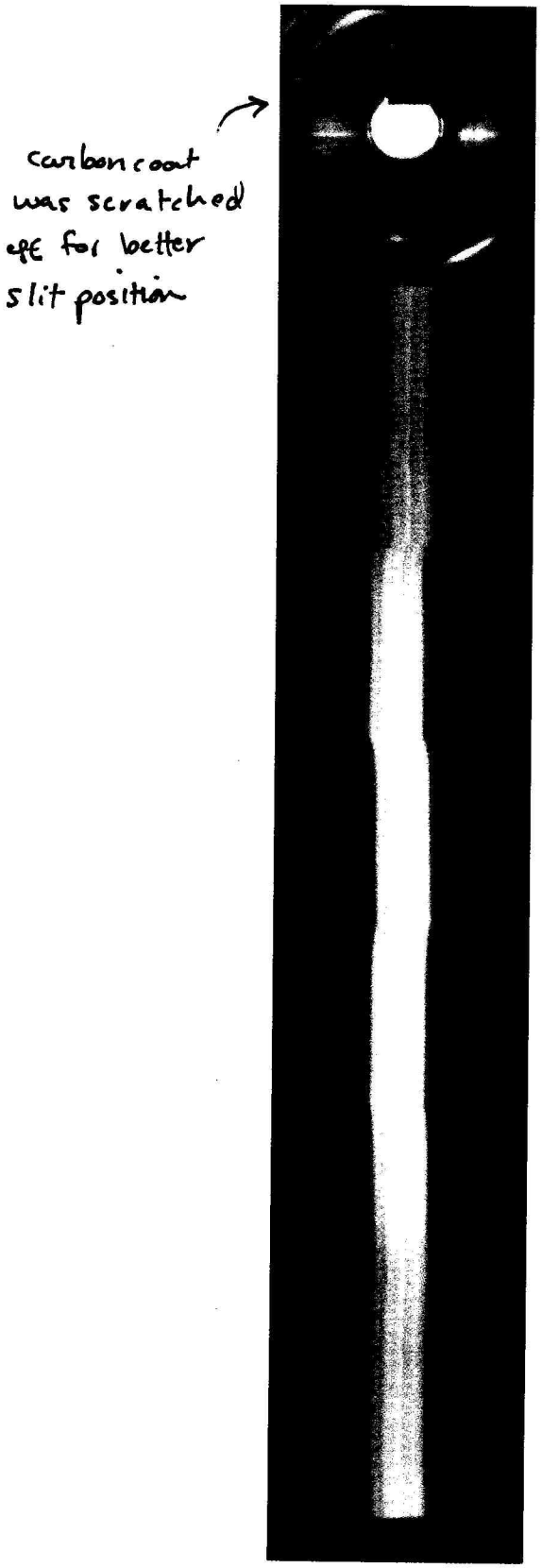
Note: The thickness of the reference zero point from the base is = **0.04260** Inches
1.08204 mm



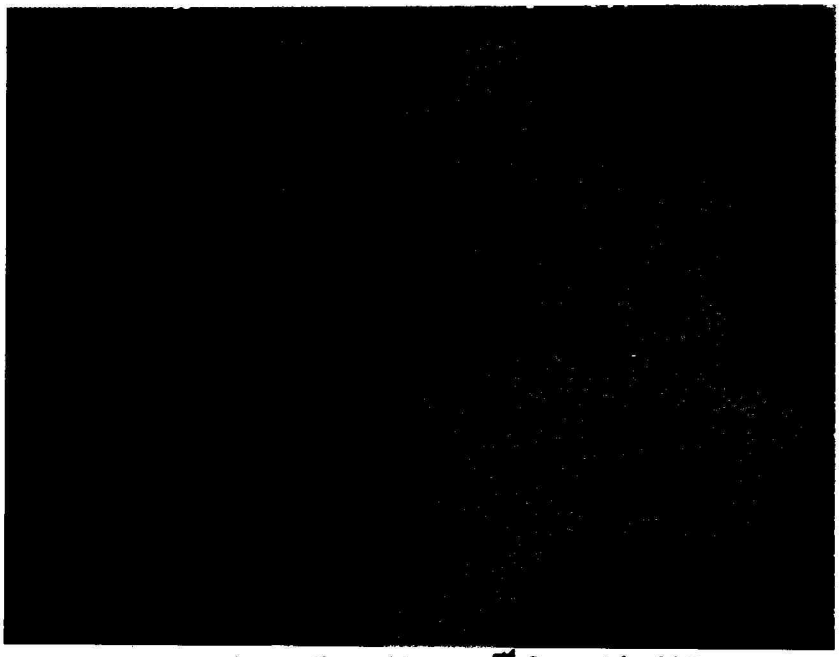
Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00035	3.6	south
2	0.200	0.00010	3.40	
3	0.400	0.00015	3.20	
4	0.600	0.00010	3.00	
5	0.800	0.00005	2.80	
6	1.000	0.00000	2.60	
7	1.200	0.00000	2.40	
8	1.400	-0.00005	2.20	
9	1.600	-0.00005	2.00	
10	1.800	-0.00005	1.80	
11	2.000	-0.00005	1.60	
12	2.200	-0.00005	1.40	
13	2.400	-0.00010	1.20	
14	2.600	-0.00005	1.00	
15	2.800	-0.00005	0.80	
16	3.000	-0.00005	0.60	
17	3.200	-0.00005	0.40	
18	3.400	-0.00005	0.20	
19	3.600	0.00000	0.00	
20	3.800	-0.00005	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00005	-0.60	
23	4.400	-0.00005	-0.80	
24	4.600	-0.00005	-1.00	
25	4.800	-0.00005	-1.20	
26	5.000	0.00000	-1.40	
27	5.200	-0.00005	-1.60	
28	5.400	0.00000	-1.80	
29	5.600	0.00000	-2.00	
30	5.800	0.00000	-2.20	
31	6.000	0.00005	-2.40	
32	6.200	0.00005	-2.60	
33	6.400	0.00005	-2.80	
34	6.600	0.00010	-3.00	
35	6.800	0.00020	-3.20	
36	7.000	0.00015	-3.40	
37	7.200	0.00030	-3.60	north

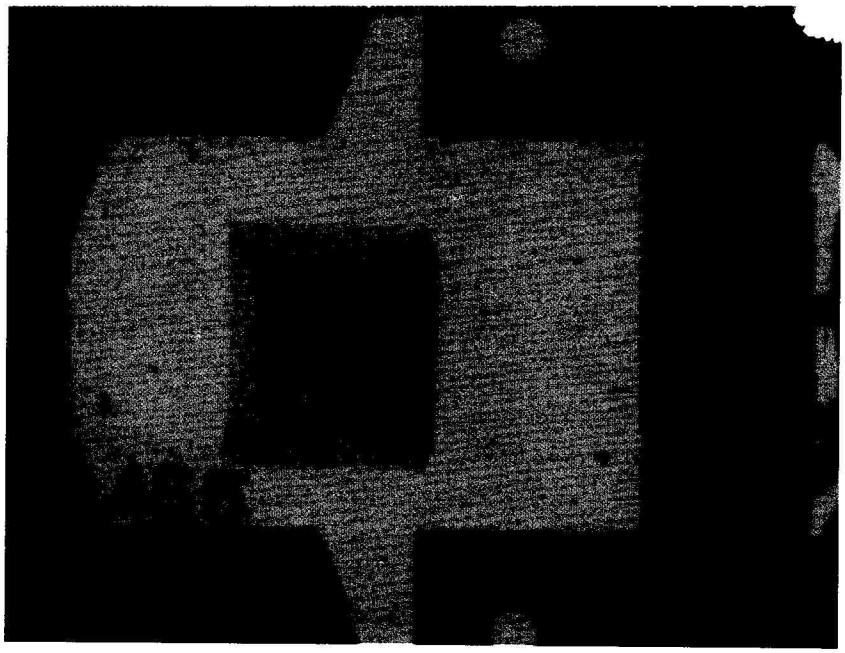
#455



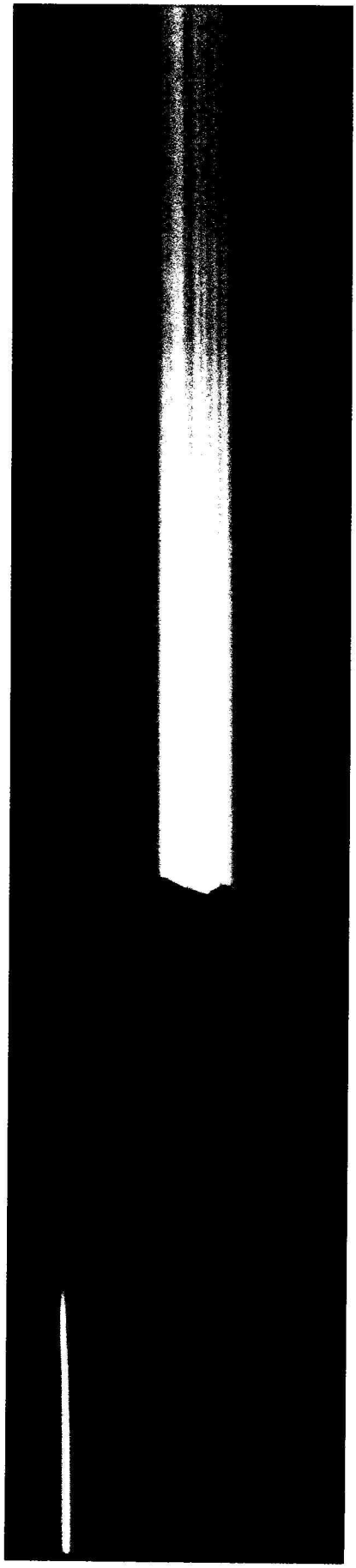
Shot 455 X-ray #1 4/7/12



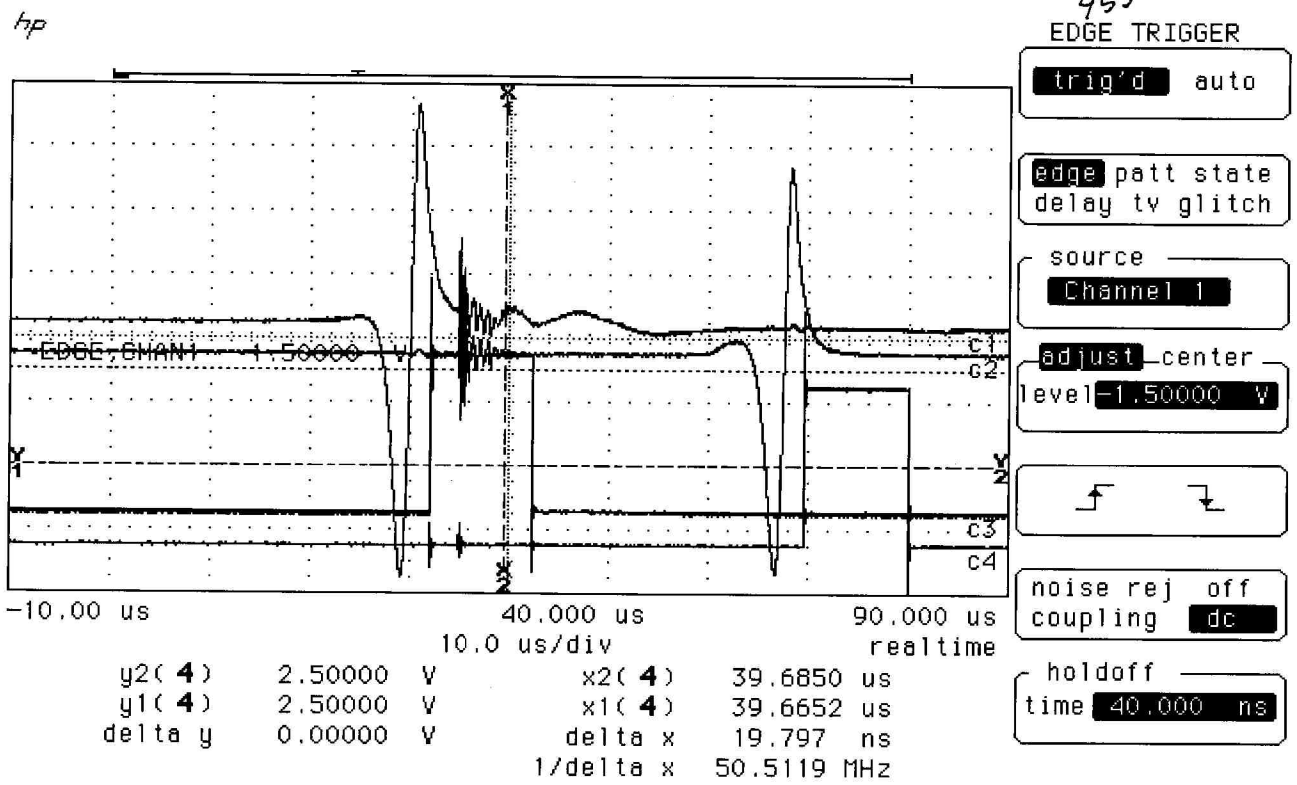
Shot 455 X-ray #2 4/7/12



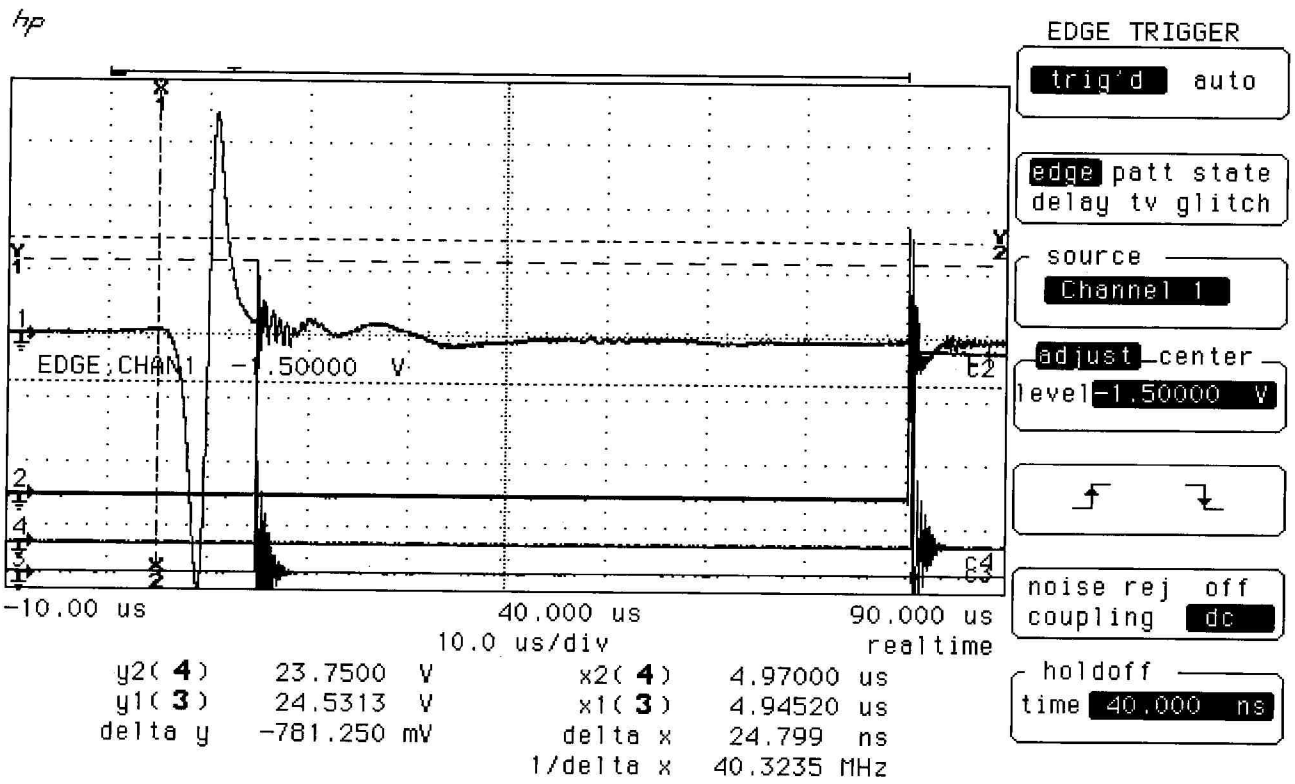
#455



HP 5
455


hp
EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 1
adjust center
level -1.50000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
EDGE,CHAN1 -1.50000 V
c1
c2
c3
c4
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(4) 2.50000 V
y1(4) 2.50000 V
delta y 0.00000 V
x2(4) 39.6850 us
x1(4) 39.6652 us
delta x 19.797 ns
1/delta x 50.5119 MHz

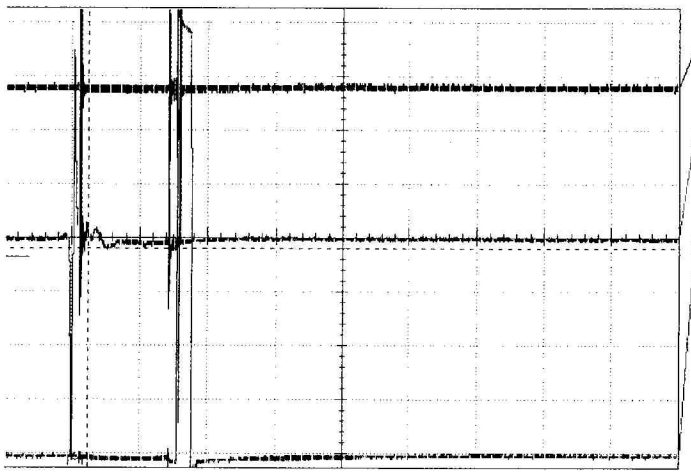
HP6 #455


hp
EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 1
adjust center
level -1.50000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
EDGE,CHAN1 -1.50000 V
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(4) 23.7500 V
y1(3) 24.5313 V
delta y -781.250 mV
x2(4) 4.97000 us
x1(3) 4.94520 us
delta x 24.799 ns
1/delta x 40.3235 MHz

457

#455

PRINTED : May-7-2012:11.43.43
PRODUCT : Classic 6500 S/N 84900024



TRC4M:
(May-7-2012:10.57.53)
100mV/div.50µs/div
TRC1M:
(May-7-2012:10.57.53)
2V/div.50µs/div
TRC3M:
(May-7-2012:10.57.53)
5V/div.50µs/div

TR3M
CURSOR :TRC2 -9.24V
+12.66.5635µs
CURSOR :TRC1 -227mV
+67.40250µs
CURSOR :TRC3 +12.2V
+67.40250µs
CURSOR :TRC4 +3.67mV
+67.40250µs

LIGHT GAS GUN DATA SHEET

Shot No. 457 Date 5/22/12

Target:

Sample Material Forsterite (#25) Crystallographic orientation —

Source Location Morton (created Gems Thickness:1 — in.

Type of Measurement Pre-heated EOS 2000°c 2. — in.

Bulk Density — gm/cc Crystal Density — gm/cc

±2 std. devs. — gm/cc ±2 std. devs. — gm/cc

Total Shorting Pin Height — in. (shim to driver) Driver Plate Thickness 1.0604 mm ~~in.~~

Material Mo

Projectile:

Weight 20.1303 gms. Length 0.9050 in. Skirt Diameter 1.1128 in.

Flyer Plate Material Mo (#5) Leading Edge Dia. 1.1009 in.

Thickness 0.6110 in. Major Dia. 0.98350 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. Pressure 100 Temp. 21.0°c

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.109 in.

Diameter: Front 3.496 in. Back 3.497 in.

Pump Tube:

Pre-Fill Pressure −28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 388.01 gms. Type IMR 4350 Total Charge 400.01 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 3.5 km/sec Piston _____ km/sec

Notes: * sample holder was preheated for leak test

~~* TO TURN~~ C TURN Coil MAGNETS USED ON THIS SHOT.

Temp. @ 4:00 min
KV - 5.8
Grid - 25

L.G.G.

Camera Streak Duration: _____ nsec Timing calibration frequency: _____ MHz

Camera Writing Rate Dial Value: _____

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1_____ µsec Flash X-ray #2_____µsec

Static Streak Photo _____ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0556 in. min. 0.0932 in. min.

0.0570 in. max. 0.0936 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 108/110 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	700 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1422 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	61.400 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	100.508 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	117.638 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	17.135 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	100.528 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	61.420 µsec
UDC Velocity:			3314.98 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	204.60 ns
HP5, 2:	Velocity magnet 2	61.6369 µsec
HP5, 3:	TTL Start	2.18240 µsec
HP5, 4:	TTL Stop	63.61720 µsec
HP6, 1:	Velocity Magnet 1	187.50 ns
HP6,2:	Xenon Lamp Trigger	118.9536 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	8.099 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	108.6258 µsec
GS7, 1:	Velocity Magnet 1	15.2425 µsec
GS7,3:	Camera Trigger (UDC HV 1)	140.3475 µsec
GS7, 4:	Camera Monitor Out	140.5878 µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	58.000 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	100.380 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	110.751 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	10.376 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	100.449 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	57.980 µsec
UDC Velocity:			3511.66 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	284.00 ns
HP5, 2:	Velocity magnet 2	58.269 µsec
HP5, 3:	TTL Start	2.309 4 µsec
HP5, 4:	TTL Stop	60.272 µsec
HP6, 1:	Velocity Magnet 1	276.40 ns
HP6,2:	Xenon Lamp Trigger	112.177 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	8.18260 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	108.629 µsec
GS7, 1:	Velocity Magnet 1	15.325 µsec
GS7, 2:	Camera Cal. Sig.	134.238 µsec
GS7,3:	Camera Trigger (UDC HV 1)	133.5595 µsec
GS7, 4:	Camera Monitor Out	133.820 µsec

Shot 457 Nominal Timeline Preshot

V	3500	
cable time	90	150
intervalometer intrinsic delay	2080	2080
UDC extra count lag	123	
pulse translator delay	150	
X-ray 1 program delay	5279	5279 X-ray 1 actual delay
X-ray 2 program delay	106177	106177 X-ray 2 actual delay
X-ray 1 pulser delay	600	
X-ray 2 pulser delay	625	
Camera intrinsic delay	107	
Lamp trigger to peak brightness	7127	
HV#3 delay to lamp	-6370	
Streak duration	1514	
Desired dead streak before driver	500	

	meters		
M1-M2 distance	0.203606	mag SIM time	58173 ns
M2-target distance	0.21524		
M2-target fudge	0.204306		
M1-fid1 distance	0.03		
M1-fid2 distance	0.383145		
Flyer thickness	0.00155194		
Us(Mo)	7168.42728		
driver thickness	0.00105918		
cap thickness	0.00078588		
estimated sample+cover time	251.14191		

	rho0	Co	s	
Cold Mo	10206	5033	1.28946405	
Hot Mo	9785	4857.9	1.2875	2000 C
Liquid Forsterit	2653.62	3772.0	1.431415	

			up	P	Us
driver	562.0825943	-191023240	3.40997E+11	1794.5843	125.877636	7168.42728
sample	8799.754822	-147977982	3.32901E+11	2675.27422	53.9636023	7601.40302
cap	-8799.75482	-98191340	1.62299E+11	1461.46696	96.378465	6739.53872

t (ns)	flyer x (m)	shock front (m)	event
0	0.00077597		M1 zero-crossing
150	0.00130097		HP5-1, GS7-1, HP6-1, Intervalometer start
2230	0.00858097		HP5-3, UDC start, signal to pulse translator
2380	0.00910597		pulse translator out
7659	0.02758247		X-ray 1 delay amp out to counters 4, 5
8349	0.02999747		X-ray 1 fires
8439	0.03031247		X-ray 1 pulse monitor at counter 4b
58173	0.20438197		M2 zero-crossing
58323	0.20490697		HP5-2, Intervalometer stop
60403	0.21218697		HP5-4, UDC stop
108557	0.38072547		X-ray 2 delay amp, stop counter 4, start counter 6
109272	0.38322797		X-ray 2 fires
109362	0.38354297		X-ray 2 pulse monitor at counter 4b
118899	0.41692365		UDC out, GS7-3, stop counters 5 and 6
118989	0.41723865		Trigger at camera
119096	0.41761315		Begin Streak
119186	0.41792815		Camera Monitor on GS7-4
119449	0.418846	0	IMPACT
119596		0.00105918	Driver arrival on streak
119847		0.002859473	Sample cutoff on streak
120610		0.008327965	End Streak

		X-ray velocity	3500
			On film
X-ray 1 flyer vs. fid (mm)		-0.00253	-0.0029419
Counter 3:	58173		
		HP5 2-1	58173
UDC upcount:	58173	HP5 4-3	58173
Counter 4:	100898		
X-ray 2 flyer vs. fid (mm)		0.08297	0.09647674
Counter 4b:	100923		
Counter 5:	111240	GS7 3-1	118749
Counter 6:	10342	GS7 4-1	119036
		HP6-1	

		scopes		
triq	GS7-1	0	10V pp	rising
sim only	GS7-2	119399	10 V _-_	ttl
	GS7-3	118749	10 V _-_	
	GS7-4	119036	(-)1.75 V	down going
triq	HP5-1	0	10V pp	rising
	HP5-2	58173	10V pp	rising
	HP5-3	2080	5 V _-_	
	HP5-4	60253	5 V _-_	
triq	HP6-1	0	10V pp	rising
HV#1-14.3us	HP6-2	112529	10 V _-_	
	HP6-3	8289	25 V /\	
	HP6-4	109212	25 V /\	

Driver cutoff on streak	500
Sample cutoff on sreak	751

MAGNET DISTANCE

Shot No. **457** Expected Velocity: **3.50**

DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement =	8.016	inch
Distance Between Magnet # 1 to Magnet # 2 =	203.606	mm
TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 =	**58.173 µsec.**	

DISTANCE BETWEEN MAGNET # 2 TO TARGET

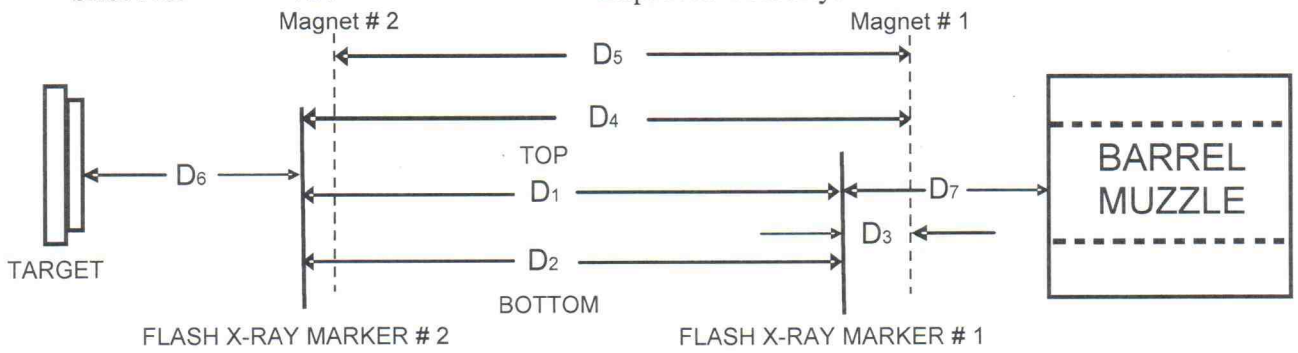
Micrometer Measurement

First measurement =	8.351	inch
Second measurement =	8.347	inch
Average measurement =	8.349	inch
Average measurement =	212.065	mm
Center line of the thickness of Magnet # 2 =	3.175	mm
Distance Between Magnet # 2 to Target =	215.240	mm
TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET =	**61.497 µsec.**	
Fudged Distance between Magnet 2 to Target =	0	mm

0.204306 meters

TARGET MEASUREMENT

Shot No. **456** Expected Velocity: **3.50** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	0.0	99.0
Measure # 2, mm	30.00	383.15	203.66	0.0	99.0
Average, mm	30.00	383.15	203.61	0.0	99.0
Travel time, µsec	**8.57**	**109.47**	**58.17**	**0.00**	**28.29**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **100.92** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **100.88** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **5.47** µsec. 5.279 µs

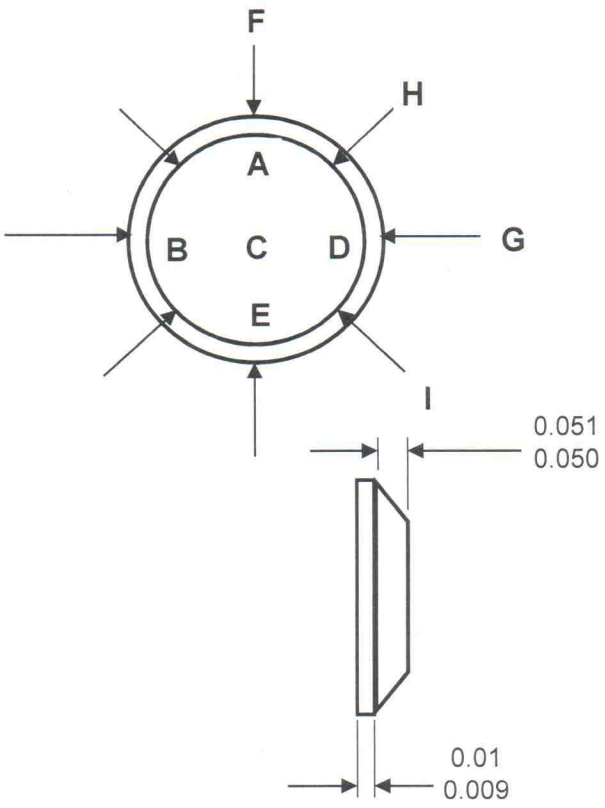
Flash X-Ray # 2 Delay (from Magnet # 1) **106.82** µsec. 106.177 µs

SHOT No.

FLYER PLATE MATERIAL: **molybdenum (5-1.55mm) - GM-LT**

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06100	F	0.98350
A	0.06115	F	0.98350
B	0.06110	G	0.98350
B	0.06110	G	0.98350
C	0.06110	H	0.92700
C	0.06115	H	0.92700
D	0.06110	I	0.92700
D	0.06095	I	0.92700
E	0.06120		
E	0.06110		



Statistic for thickness

N	10
MAX	0.06120
MIN	0.06095
Range	0.00025
MEAN	0.06110
STDEV	7.24569E-05

Statistic for Diameter (F-G)

N	4
MAX	0.98350
MIN	0.98350
Range	0.00000
MEAN	0.9835000
STDEV	0

Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927
STDEV	0

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1			7.2144			10.2380
2			7.2141			10.2180
3			7.2142			10.1900
	THICKNESS		0.061095	±	in	
	FLATNESS:		0.00025	in.		
	VOLUME:		0.7606	1.84E-04	cm^3	
	CRYSTAL DENSITY:		10.2153	2.41E-02	$grams/cm^3$	
	BULK DENSITY:		9.4852	2.39E-04	$grams/cm^3$	

DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED BY: _____ on _____

SHOT No. _____ tip used: .7mm long/ flat tip

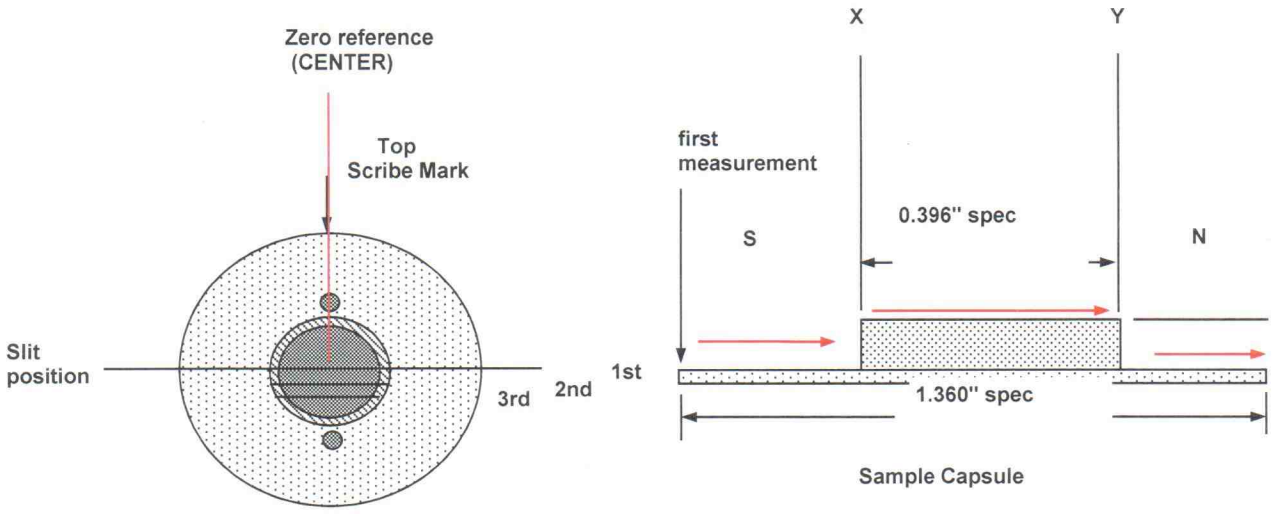
SAMPLE CAPSULE: 25 note: the platform on which the measu

SAMPLE MATERIAL: deviates from flat by +0.013 max.

direction of measurement

4.849

THICKNESS PROFILE (Not re-polished, but final surface) 1.792



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00081

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00000

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

Average thickness reading = 0.00000

Note: Measurement from reference zero point from the base is = **0.1736**

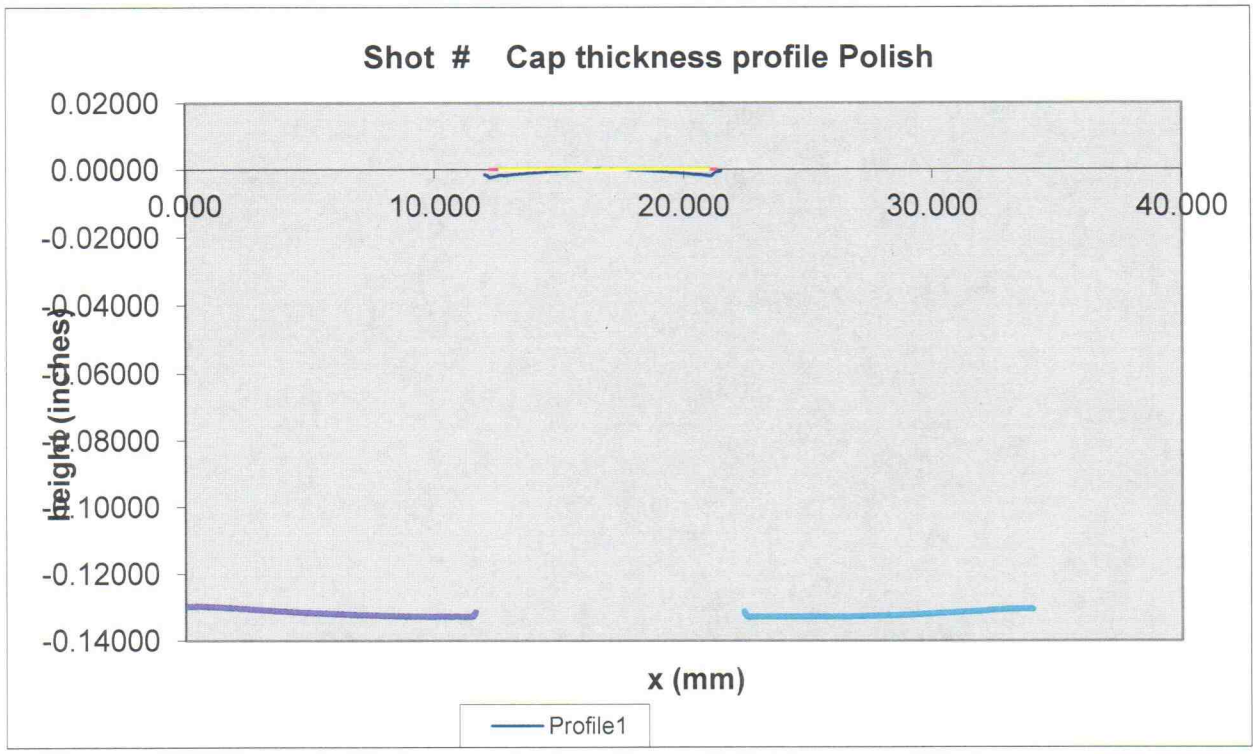
4.4094

Average thickness of the driver Plate = 0.0417

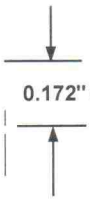
1.0604

Thickness of the Carbon Deposited on the coil side is =

Thickness of the C Deposited on the Projectile side is =


Shot # Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
0.000
10.000
20.000
30.000
40.000
Height (inches)
x (mm)
Profile1

rement was taken



Inches
mm

Inches
mm

nm

nm

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Bel 3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment							
# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s
1	0.000	17.000	-0.13005	225	22.400	-5.400	-0.13130
2	0.100	16.900	-0.12985	226	22.500	-5.500	-0.13285
3	0.200	16.800	-0.12985	227	22.600	-5.600	-0.13290
4	0.300	16.700	-0.12980	228	22.700	-5.700	-0.13285
5	0.400	16.600	-0.12980	229	22.800	-5.800	-0.13285
6	0.500	16.500	-0.12975	230	22.900	-5.900	-0.13280
7	0.600	16.400	-0.12975	231	23.000	-6.000	-0.13285
8	0.700	16.300	-0.12985	232	23.100	-6.100	-0.13285
9	0.800	16.200	-0.12985	233	23.200	-6.200	-0.13280
10	0.900	16.100	-0.12990	234	23.300	-6.300	-0.13280
11	1.000	16.000	-0.12995	235	23.400	-6.400	-0.13280
12	1.100	15.900	-0.12995	236	23.500	-6.500	-0.13280
13	1.200	15.800	-0.13000	237	23.600	-6.600	-0.13285
14	1.300	15.700	-0.13000	238	23.700	-6.700	-0.13285
15	1.400	15.600	-0.13005	239	23.800	-6.800	-0.13285
16	1.500	15.500	-0.13010	240	23.900	-6.900	-0.13280
17	1.600	15.400	-0.13020	241	24.000	-7.000	-0.13285
18	1.700	15.300	-0.13020	242	24.100	-7.100	-0.13285
19	1.800	15.200	-0.13025	243	24.200	-7.200	-0.13285
20	1.900	15.100	-0.13030	244	24.300	-7.300	-0.13285
21	2.000	15.000	-0.13035	245	24.400	-7.400	-0.13285
22	2.100	14.900	-0.13045	246	24.500	-7.500	-0.13285
23	2.200	14.800	-0.13050	247	24.600	-7.600	-0.13285
24	2.300	14.700	-0.13050	248	24.700	-7.700	-0.13280
25	2.400	14.600	-0.13055	249	24.800	-7.800	-0.13280
26	2.500	14.500	-0.13060	250	24.900	-7.900	-0.13285
27	2.600	14.400	-0.13070	251	25.000	-8.000	-0.13285
28	2.700	14.300	-0.13075	252	25.100	-8.100	-0.13285
29	2.800	14.200	-0.13080	253	25.200	-8.200	-0.13285
30	2.900	14.100	-0.13085	254	25.300	-8.300	-0.13285
31	3.000	14.000	-0.13090	255	25.400	-8.400	-0.13280
32	3.100	13.900	-0.13090	256	25.500	-8.500	-0.13285
33	3.200	13.800	-0.13095	257	25.600	-8.600	-0.13280
34	3.300	13.700	-0.13095	258	25.700	-8.700	-0.13280
35	3.400	13.600	-0.13100	259	25.800	-8.800	-0.13280
36	3.500	13.500	-0.13110	260	25.900	-8.900	-0.13280
37	3.600	13.400	-0.13115	261	26.000	-9.000	-0.13275
38	3.700	13.300	-0.13120	262	26.100	-9.100	-0.13275
39	3.800	13.200	-0.13120	263	26.200	-9.200	-0.13275
40	3.900	13.100	-0.13130	264	26.300	-9.300	-0.13275
41	4.000	13.000	-0.13130	265	26.400	-9.400	-0.13270
42	4.100	12.900	-0.13140	266	26.500	-9.500	-0.13270
43	4.200	12.800	-0.13140	267	26.600	-9.600	-0.13270
44	4.300	12.700	-0.13145	268	26.700	-9.700	-0.13270
45	4.400	12.600	-0.13145	269	26.800	-9.800	-0.13265
46	4.500	12.500	-0.13150	270	26.900	-9.900	-0.13265
47	4.600	12.400	-0.13155	271	27.000	-10.000	-0.13265
48	4.700	12.300	-0.13160	272	27.100	-10.100	-0.13265
49	4.800	12.200	-0.13165	273	27.200	-10.200	-0.13260
50	4.900	12.100	-0.13165	274	27.300	-10.300	-0.13255
51	5.000	12.000	-0.13170	275	27.400	-10.400	-0.13255
52	5.100	11.900	-0.13175	276	27.500	-10.500	-0.13255
53	5.200	11.800	-0.13175	277	27.600	-10.600	-0.13255
54	5.300	11.700	-0.13180	278	27.700	-10.700	-0.13250
55	5.400	11.600	-0.13180	279	27.800	-10.800	-0.13245
56	5.500	11.500	-0.13185	280	27.900	-10.900	-0.13240
57	5.600	11.400	-0.13185	281	28.000	-11.000	-0.13245

58	5.700	11.300	-0.13195	282	28.100	-11.100	-0.13240
59	5.800	11.200	-0.13195	283	28.200	-11.200	-0.13235
60	5.900	11.100	-0.13200	284	28.300	-11.300	-0.13240
61	6.000	11.000	-0.13205	285	28.400	-11.400	-0.13235
62	6.100	10.900	-0.13205	286	28.500	-11.500	-0.13235
63	6.200	10.800	-0.13210	287	28.600	-11.600	-0.13230
64	6.300	10.700	-0.13210	288	28.700	-11.700	-0.13225
65	6.400	10.600	-0.13215	289	28.800	-11.800	-0.13225
66	6.500	10.500	-0.13215	290	28.900	-11.900	-0.13220
67	6.600	10.400	-0.13220	291	29.000	-12.000	-0.13220
68	6.700	10.300	-0.13220	292	29.100	-12.100	-0.13215
69	6.800	10.200	-0.13225	293	29.200	-12.200	-0.13215
70	6.900	10.100	-0.13230	294	29.300	-12.300	-0.13205
71	7.000	10.000	-0.13230	295	29.400	-12.400	-0.13205
72	7.100	9.900	-0.13230	296	29.500	-12.500	-0.13205
73	7.200	9.800	-0.13230	297	29.600	-12.600	-0.13200
74	7.300	9.700	-0.13230	298	29.700	-12.700	-0.13195
75	7.400	9.600	-0.13240	299	29.800	-12.800	-0.13190
76	7.500	9.500	-0.13240	300	29.900	-12.900	-0.13190
77	7.600	9.400	-0.13245	301	30.000	-13.000	-0.13185
78	7.700	9.300	-0.13245	302	30.100	-13.100	-0.13175
79	7.800	9.200	-0.13250	303	30.200	-13.200	-0.13170
80	7.900	9.100	-0.13250	304	30.300	-13.300	-0.13165
81	8.000	9.000	-0.13250	305	30.400	-13.400	-0.13165
82	8.100	8.900	-0.13250	306	30.500	-13.500	-0.13165
83	8.200	8.800	-0.13255	307	30.600	-13.600	-0.13160
84	8.300	8.700	-0.13255	308	30.700	-13.700	-0.13155
85	8.400	8.600	-0.13260	309	30.800	-13.800	-0.13155
86	8.500	8.500	-0.13260	310	30.900	-13.900	-0.13150
87	8.600	8.400	-0.13260	311	31.000	-14.000	-0.13145
88	8.700	8.300	-0.13265	312	31.100	-14.100	-0.13135
89	8.800	8.200	-0.13270	313	31.200	-14.200	-0.13135
90	8.900	8.100	-0.13265	314	31.300	-14.300	-0.13130
91	9.000	8.000	-0.13270	315	31.400	-14.400	-0.13130
92	9.100	7.900	-0.13270	316	31.500	-14.500	-0.13125
93	9.200	7.800	-0.13270	317	31.600	-14.600	-0.13120
94	9.300	7.700	-0.13270	318	31.700	-14.700	-0.13120
95	9.400	7.600	-0.13270	319	31.800	-14.800	-0.13110
96	9.500	7.500	-0.13275	320	31.900	-14.900	-0.13110
97	9.600	7.400	-0.13275	321	32.000	-15.000	-0.13100
98	9.700	7.300	-0.13280	322	32.100	-15.100	-0.13095
99	9.800	7.200	-0.13280	323	32.200	-15.200	-0.13090
100	9.900	7.100	-0.13280	324	32.300	-15.300	-0.13085
101	10.000	7.000	-0.13280	325	32.400	-15.400	-0.13080
102	10.100	6.900	-0.13275	326	32.500	-15.500	-0.13075
103	10.200	6.800	-0.13275	327	32.600	-15.600	-0.13070
104	10.300	6.700	-0.13275	328	32.700	-15.700	-0.13070
105	10.400	6.600	-0.13275	329	32.800	-15.800	-0.13065
106	10.500	6.500	-0.13275	330	32.900	-15.900	-0.13060
107	10.600	6.400	-0.13280	331	33.000	-16.000	-0.13055
108	10.700	6.300	-0.13280	332	33.100	-16.100	-0.13050
109	10.800	6.200	-0.13275	333	33.200	-16.200	-0.13050
110	10.900	6.100	-0.13275	334	33.300	-16.300	-0.13045
111	11.000	6.000	-0.13280	335	33.400	-16.400	-0.13050
112	11.100	5.900	-0.13285	336	33.500	-16.500	-0.13045
113	11.200	5.800	-0.13280	337	33.600	-16.600	-0.13045
114	11.300	5.700	-0.13280	338	33.700	-16.700	-0.13040
115	11.400	5.600	-0.13285	339	33.800	-16.800	-0.13045
116	11.500	5.500	-0.13270	340	33.900	-16.900	-0.13045
117	11.600	5.400	-0.13145	341	34.000	-17.000	-0.13050

ow the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm	1st	2nd	3 rd
118	11.700	5.300	Run	Run	Run
119	11.800	5.200	Reading	Reading	Reading
120	11.900	5.100	Inches	Inches	Inches
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	-0.00150		
125	12.400	4.600	-0.00175		
126	12.500	4.500	-0.00245	0.00000	
127	12.600	4.400	-0.00235	0.00000	
128	12.700	4.300	-0.00210	0.00000	
129	12.800	4.200	-0.00195	0.00000	
130	12.900	4.100	-0.00175	0.00000	0.00000
131	13.000	4.000	-0.00175	0.00000	0.00000
132	13.100	3.900	-0.00180	0.00000	0.00000
133	13.200	3.800	-0.00170	0.00000	0.00000
134	13.300	3.700	-0.00165	0.00000	0.00000
135	13.400	3.600	-0.00155	0.00000	0.00000
136	13.500	3.500	-0.00145	0.00000	0.00000
137	13.600	3.400	-0.00145	0.00000	0.00000
138	13.700	3.300	-0.00130	0.00000	0.00000
139	13.800	3.200	-0.00135	0.00000	0.00000
140	13.900	3.100	-0.00130	0.00000	0.00000
141	14.000	3.000	-0.00120	0.00000	0.00000
142	14.100	2.900	-0.00110	0.00000	0.00000
143	14.200	2.800	-0.00105	0.00000	0.00000
144	14.300	2.700	-0.00100	0.00000	0.00000
145	14.400	2.600	-0.00095	0.00000	0.00000
146	14.500	2.500	-0.00085	0.00000	0.00000
147	14.600	2.400	-0.00085	0.00000	0.00000
148	14.700	2.300	-0.00075	0.00000	0.00000
149	14.800	2.200	-0.00075	0.00000	0.00000
150	14.900	2.100	-0.00065	0.00000	0.00000
151	15.000	2.000	-0.00060	0.00000	0.00000
152	15.100	1.900	-0.00055	0.00000	0.00000
153	15.200	1.800	-0.00055	0.00000	0.00000
154	15.300	1.700	-0.00045	0.00000	0.00000
155	15.400	1.600	-0.00040	0.00000	0.00000
156	15.500	1.500	-0.00035	0.00000	0.00000
157	15.600	1.400	-0.00035	0.00000	0.00000
158	15.700	1.300	-0.00030	0.00000	0.00000
159	15.800	1.200	-0.00030	0.00000	0.00000
160	15.900	1.100	-0.00025	0.00000	0.00000
161	16.000	1.000	-0.00015	0.00000	0.00000
162	16.100	0.900	-0.00015	0.00000	0.00000
163	16.200	0.800	-0.00010	0.00000	0.00000
164	16.300	0.700	-0.00005	0.00000	0.00000
165	16.400	0.600	-0.00005	0.00000	0.00000
166	16.500	0.500	0.00000	0.00000	0.00000
167	16.600	0.400	0.00000	0.00000	0.00000
168	16.700	0.300	0.00005	0.00000	0.00000
169	16.800	0.200	0.00005	0.00000	0.00000
170	16.900	0.100	0.00005	0.00000	0.00000
171	17.000	0.000	0.00000	0.00000	0.00000
172	17.100	-0.100	0.00000	0.00000	0.00000
173	17.200	-0.200	0.00000	0.00000	0.00000
174	17.300	-0.300	0.00000	0.00000	0.00000

175	17.400	-0.400	0.00005	0.00000	0.00000
176	17.500	-0.500	0.00000	0.00000	0.00000
177	17.600	-0.600	0.00000	0.00000	0.00000
178	17.700	-0.700	-0.00005	0.00000	0.00000
179	17.800	-0.800	-0.00005	0.00000	0.00000
180	17.900	-0.900	-0.00005	0.00000	0.00000
181	18.000	-1.000	-0.00010	0.00000	0.00000
182	18.100	-1.100	-0.00010	0.00000	0.00000
183	18.200	-1.200	-0.00015	0.00000	0.00000
184	18.300	-1.300	-0.00020	0.00000	0.00000
185	18.400	-1.400	-0.00025	0.00000	0.00000
186	18.500	-1.500	-0.00025	0.00000	0.00000
187	18.600	-1.600	-0.00030	0.00000	0.00000
188	18.700	-1.700	-0.00035	0.00000	0.00000
189	18.800	-1.800	-0.00040	0.00000	0.00000
190	18.900	-1.900	-0.00045	0.00000	0.00000
191	19.000	-2.000	-0.00045	0.00000	0.00000
192	19.100	-2.100	-0.00055	0.00000	0.00000
193	19.200	-2.200	-0.00055	0.00000	0.00000
194	19.300	-2.300	-0.00065	0.00000	0.00000
195	19.400	-2.400	-0.00065	0.00000	0.00000
196	19.500	-2.500	-0.00075	0.00000	0.00000
197	19.600	-2.600	-0.00080	0.00000	0.00000
198	19.700	-2.700	-0.00085	0.00000	0.00000
199	19.800	-2.800	-0.00095	0.00000	0.00000
200	19.900	-2.900	-0.00095	0.00000	0.00000
201	20.000	-3.000	-0.00100	0.00000	0.00000
202	20.100	-3.100	-0.00105	0.00000	0.00000
203	20.200	-3.200	-0.00115	0.00000	0.00000
204	20.300	-3.300	-0.00120	0.00000	0.00000
205	20.400	-3.400	-0.00130	0.00000	0.00000
206	20.500	-3.500	-0.00135	0.00000	0.00000
207	20.600	-3.600	-0.00145	0.00000	0.00000
208	20.700	-3.700	-0.00150	0.00000	0.00000
209	20.800	-3.800	-0.00155	0.00000	0.00000
210	20.900	-3.900	-0.00160	0.00000	0.00000
211	21.000	-4.000	-0.00165	0.00000	0.00000
212	21.100	-4.100	-0.00175	0.00000	0.00000
213	21.200	-4.200	-0.00180	0.00000	0.00000
214	21.300	-4.300	-0.00195	0.00000	0.00000
215	21.400	-4.400	-0.00205	0.00000	
216	21.500	-4.500	-0.00130	0.00000	
217	21.600	-4.600	-0.00080	0.00000	
218	21.700	-4.700	-0.00070		
219	21.800	-4.800	-0.00050		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

Carbon coating
5/11/2012
Claire Thomas

		No. of coatings					
Sample Holder		**1**	**2**	**3**	**4**	**5**	**6**
Fo 25,29,30	sample-side	15.5	14.6	14.5	14.7		
	projectile (driver) side	13.2	14.6	15.7	15.5		

Total

59.3

59

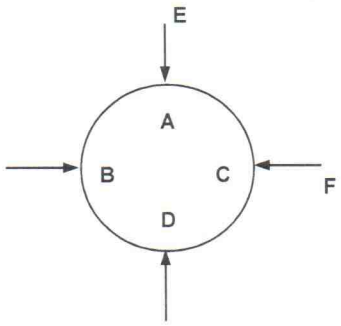
SHOT No. _____

LGG Moly Capsule Cap 11/18/2010

SAMPLE MATERIAL: Mo 25

Post polish

Thickness Measurement	
A	0.03090
A	0.03085
B	0.03120
B	0.03105
C	0.03085
C	0.03090
D	0.03085
D	0.03095



Diameter Measurement	
E	0.35350
E	0.35350
F	0.35350
F	0.35350
AVE	0.35350
Radius	0.1768

Statistic for thickness	
N	8
MAX	0.03120
MIN	0.0309
Range	0.00035
MEAN	0.03094
STDEV	0.000123744

Statistic for perimeter	
N	4
MAX	0.35350
MIN	0.3535
Range	0
MEAN	0.3535
STDEV	0

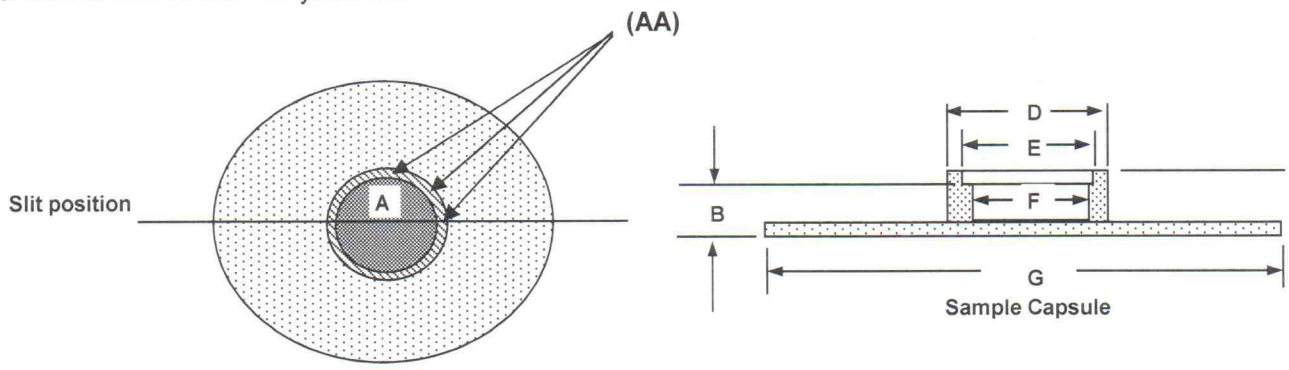
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03094375	±	mm	
	FLATNESS:		0.00035			
	VOLUME:		0.0498		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		9.9918		$grams/cm^3$	

SHOT No.: post polish

SAMPLE CAPSULE: 25

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04010
A	0.04015
A	0.04010
A	0.04010
Avg	0.04011

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17155
C	0.17140
C	0.17150
C	0.17155
D	0.3960
D	0.3965

Measurement for (B) is intervals starting at the clockwise around the e the inner lip. (see exam

B point 1(top)
B point 2
B point 3
B point 4
B point 5
B point 6
B point 7
B point 8

Statistics

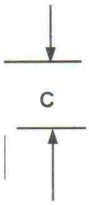
N
MAX
MIN
Range
Average

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3535
F	0.3145
F	0.3140
G	1.3590
G	1.3595
H	0.10081

MEASUREMENT BY:		Claire		
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene
1	21.8	1.88200	10.65532	11.63431	0.8640
2	21.8	1.88204	10.65544	11.63430	0.8640
3	21.8	1.88200	10.65536	11.63438	0.8640
	THICKNESS:			±	mm
	FLATNESS:			mm	
	VOLUME:				cm^3
	CRYSTAL DENSITY:		10.1943	1.17E-03	grams/cm^3
	BULK DENSITY:				grams/cm^3

attached sheet)



taken at 45 degree
top and moving
entire circumference of
ple AA)

0.14095
0.14090
0.14090
0.14085
0.14090
0.14090
0.14095
0.14100

	8
	0.14100
	0.14085
	0.00015

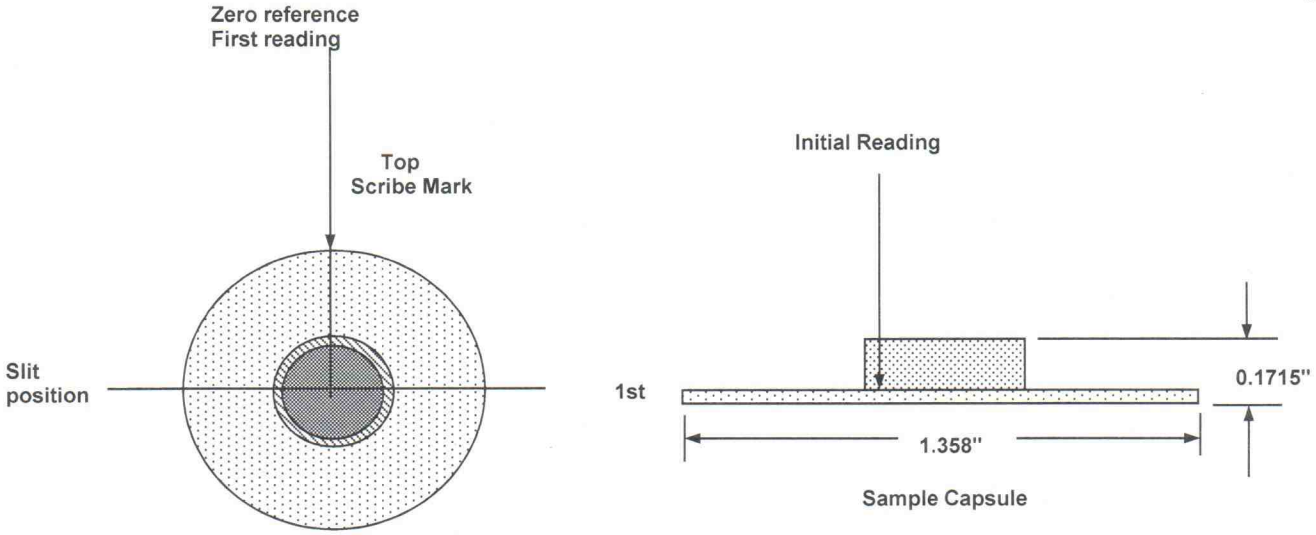
0.14092

Crystal Density
10.1948
10.1930
10.1952

SAMPLE CAPSULE: **25**
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

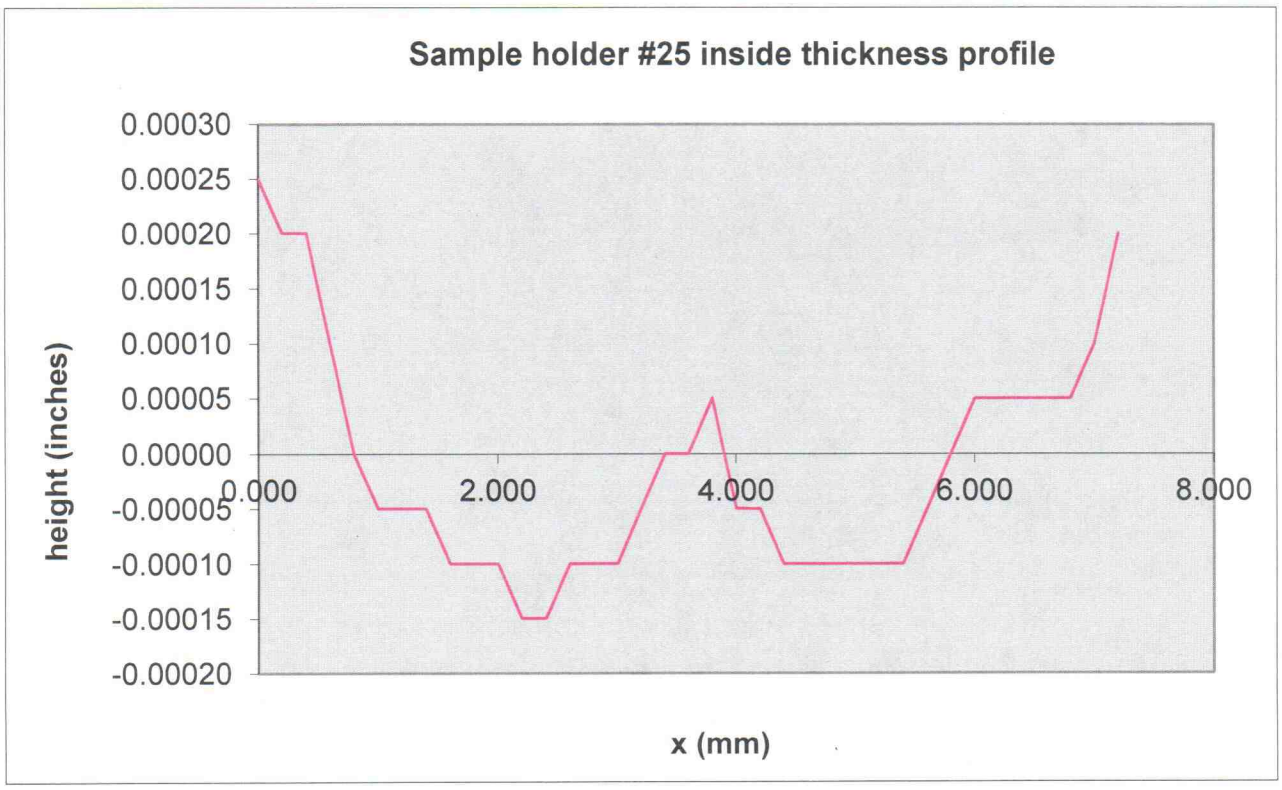
4.683
4.623



1.338582677

Average thickness reading = -0.00001

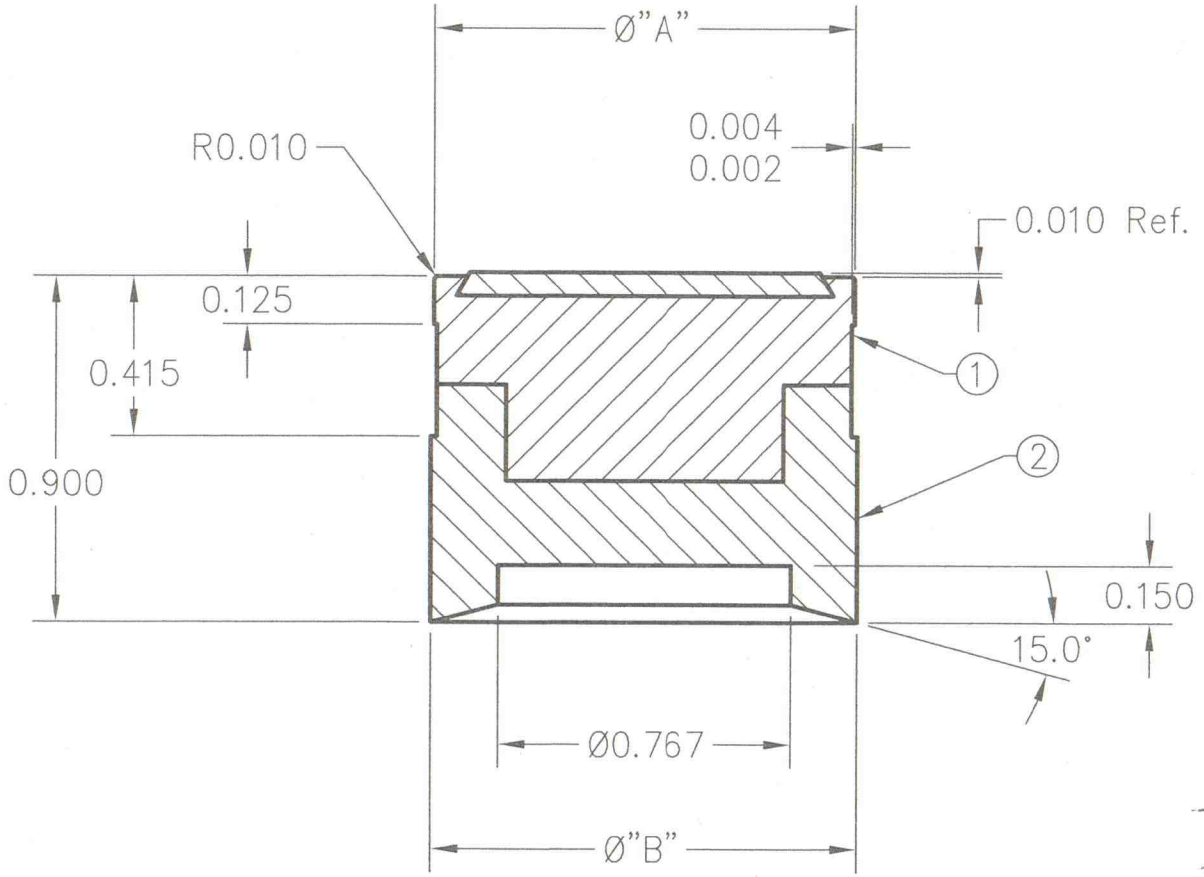
Note: The thickness of the reference zero point from the base is = **0.04430** Inches
1.12522 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00025	3.6	south
2	0.200	0.00020	3.40	
3	0.400	0.00020	3.20	
4	0.600	0.00010	3.00	
5	0.800	0.00000	2.80	
6	1.000	-0.00005	2.60	
7	1.200	-0.00005	2.40	
8	1.400	-0.00005	2.20	
9	1.600	-0.00010	2.00	
10	1.800	-0.00010	1.80	
11	2.000	-0.00010	1.60	
12	2.200	-0.00015	1.40	
13	2.400	-0.00015	1.20	
14	2.600	-0.00010	1.00	
15	2.800	-0.00010	0.80	
16	3.000	-0.00010	0.60	
17	3.200	-0.00005	0.40	
18	3.400	0.00000	0.20	
19	3.600	0.00000	0.00	
20	3.800	0.00005	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00005	-0.60	
23	4.400	-0.00010	-0.80	
24	4.600	-0.00010	-1.00	
25	4.800	-0.00010	-1.20	
26	5.000	-0.00010	-1.40	
27	5.200	-0.00010	-1.60	
28	5.400	-0.00010	-1.80	
29	5.600	-0.00005	-2.00	
30	5.800	0.00000	-2.20	
31	6.000	0.00005	-2.40	
32	6.200	0.00005	-2.60	
33	6.400	0.00005	-2.80	
34	6.600	0.00005	-3.00	
35	6.800	0.00005	-3.20	
36	7.000	0.00010	-3.40	
37	7.200	0.00020	-3.60	north

.0119



SHOT# 457

PS# 5821

BUILT AS	SHOT#		
1.1007	A	1.1009	+.0000 −.0005
1.1134	B	1.1128	+.0005 −.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−128	1
1	Sabot & Flyer Plate	LGG−157	1

Note: Super Glue & Press Fit 1 & 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

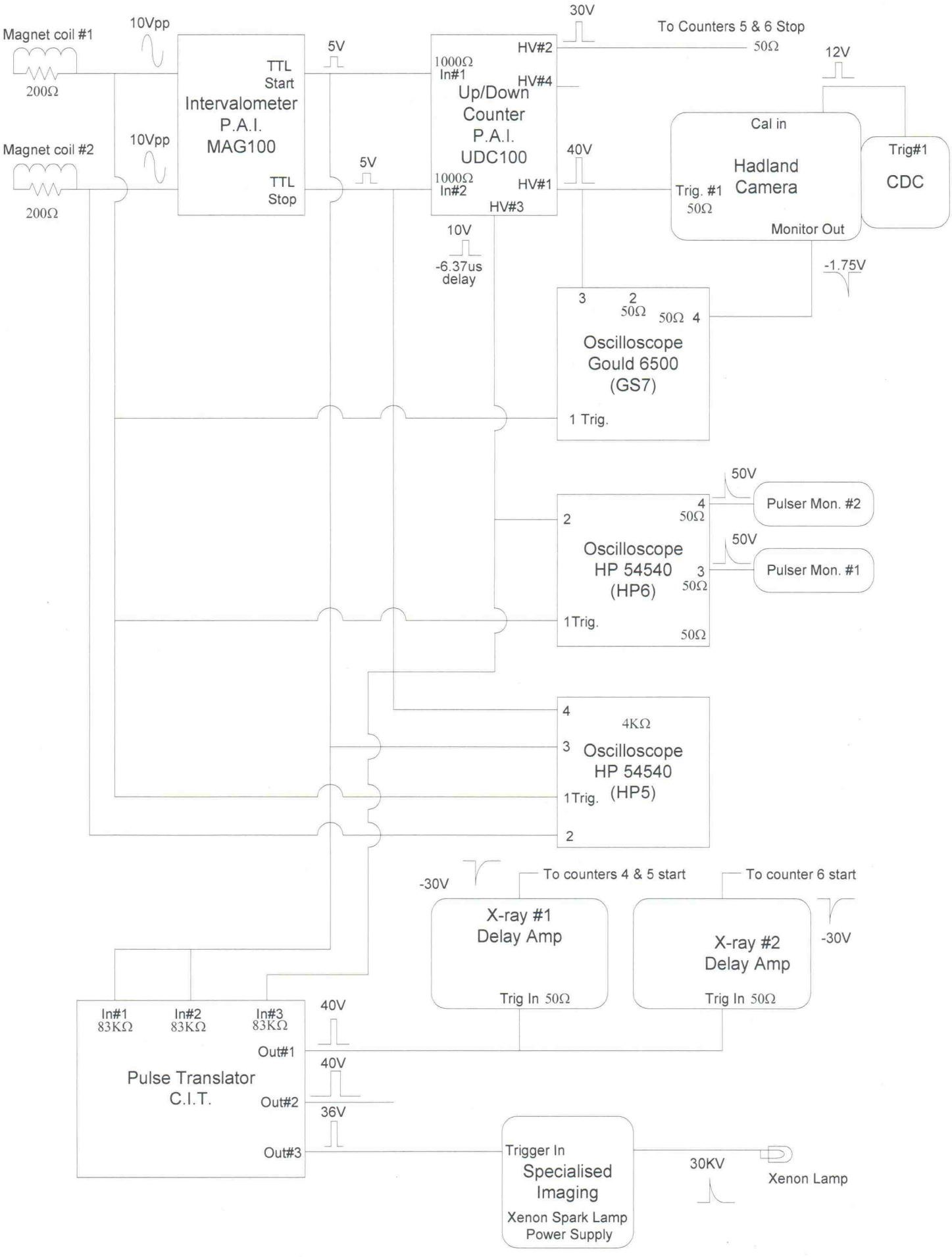
DRAWN M. Long DATE 11/29/10
ENGINEER DATE
APPROVED DATE

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

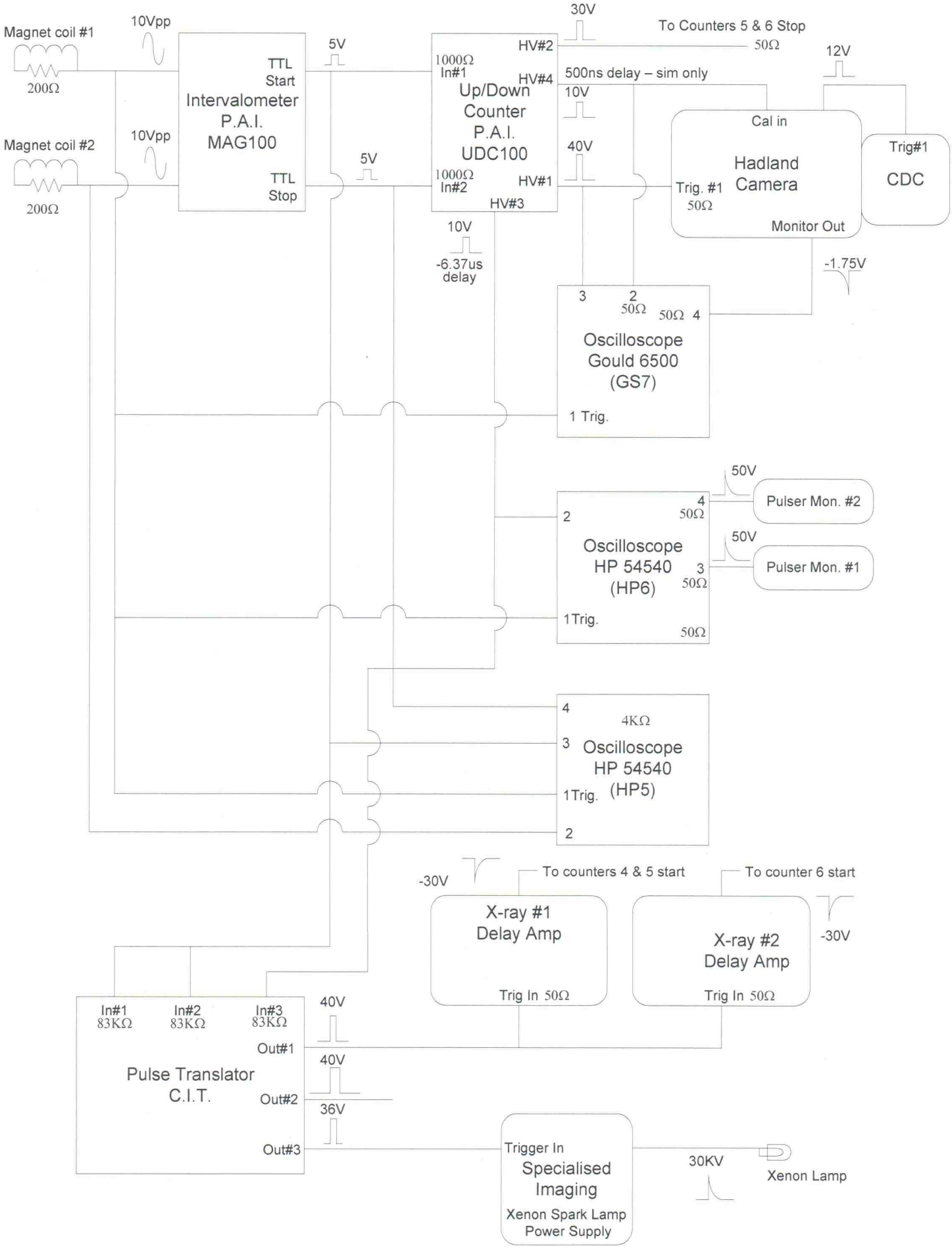
TITLE
Projectile Assy.
for 28mm launch tube (GM)

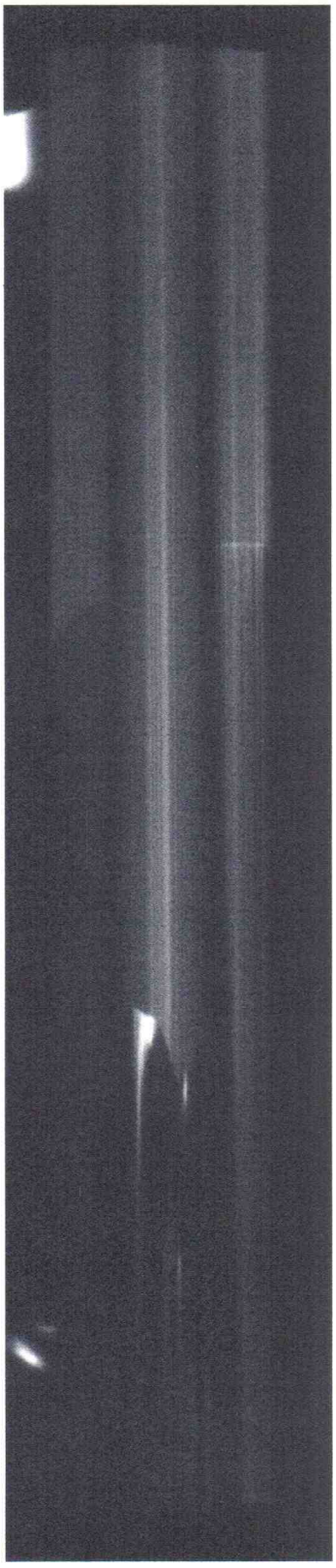
FINISH 16
MATERIAL Zelux−M&HDP
SCALE 2:1
SHEET 2 of 2
A
DRAWING NUMBER LGG−158

Shot #457 [redacted] Scope Schematic



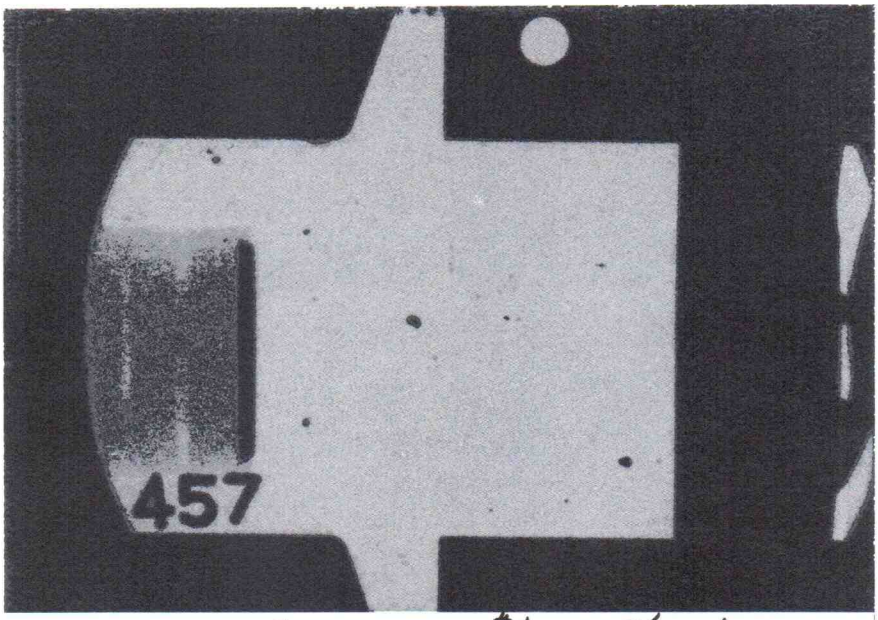
Shot #457 SIM Scope Schematic



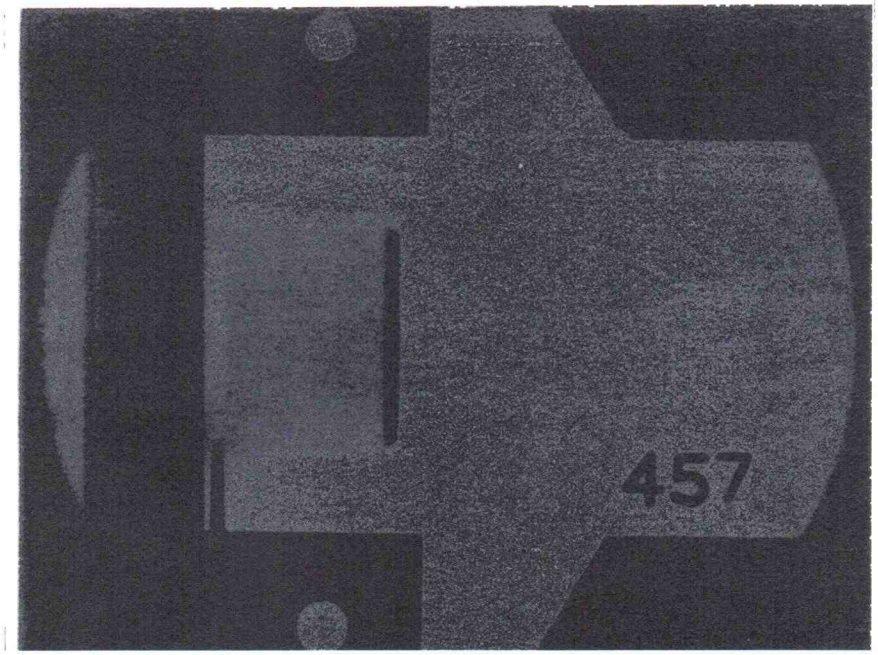


457

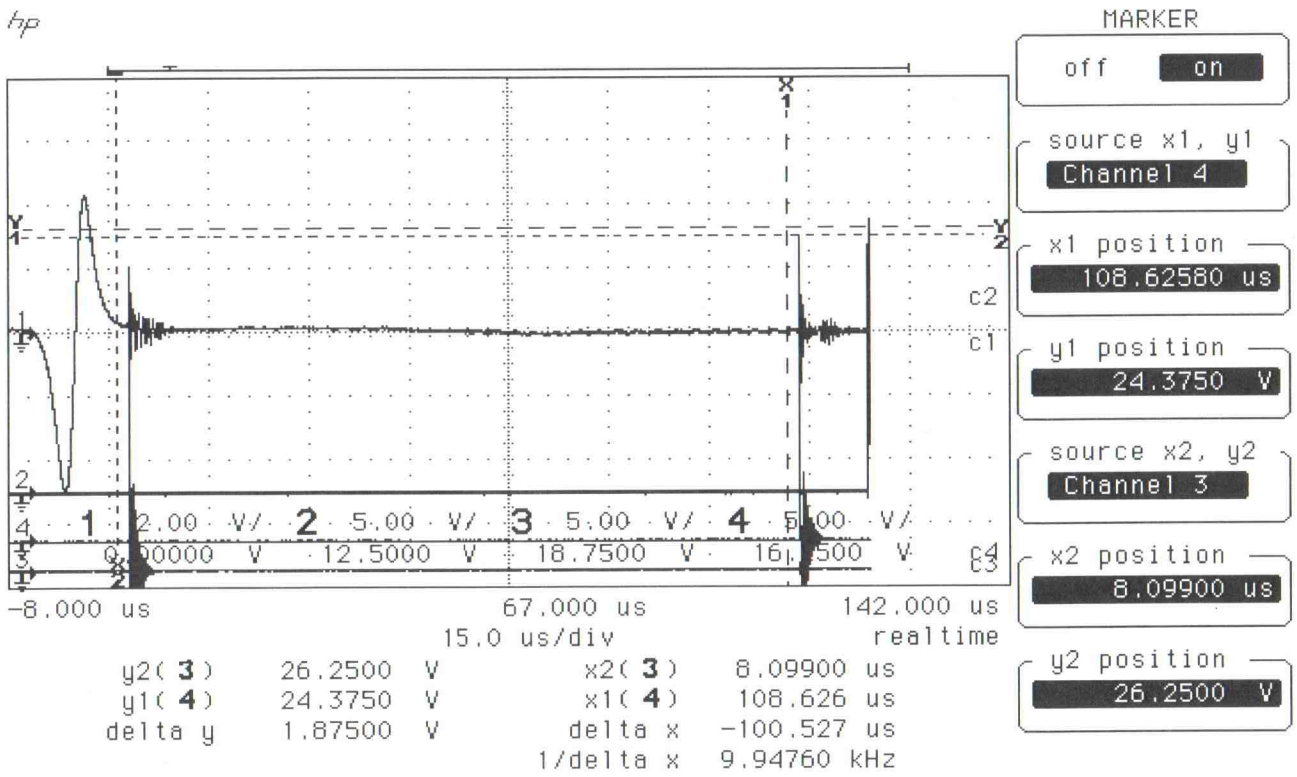
Shot 457 Xray #2 5/22/12



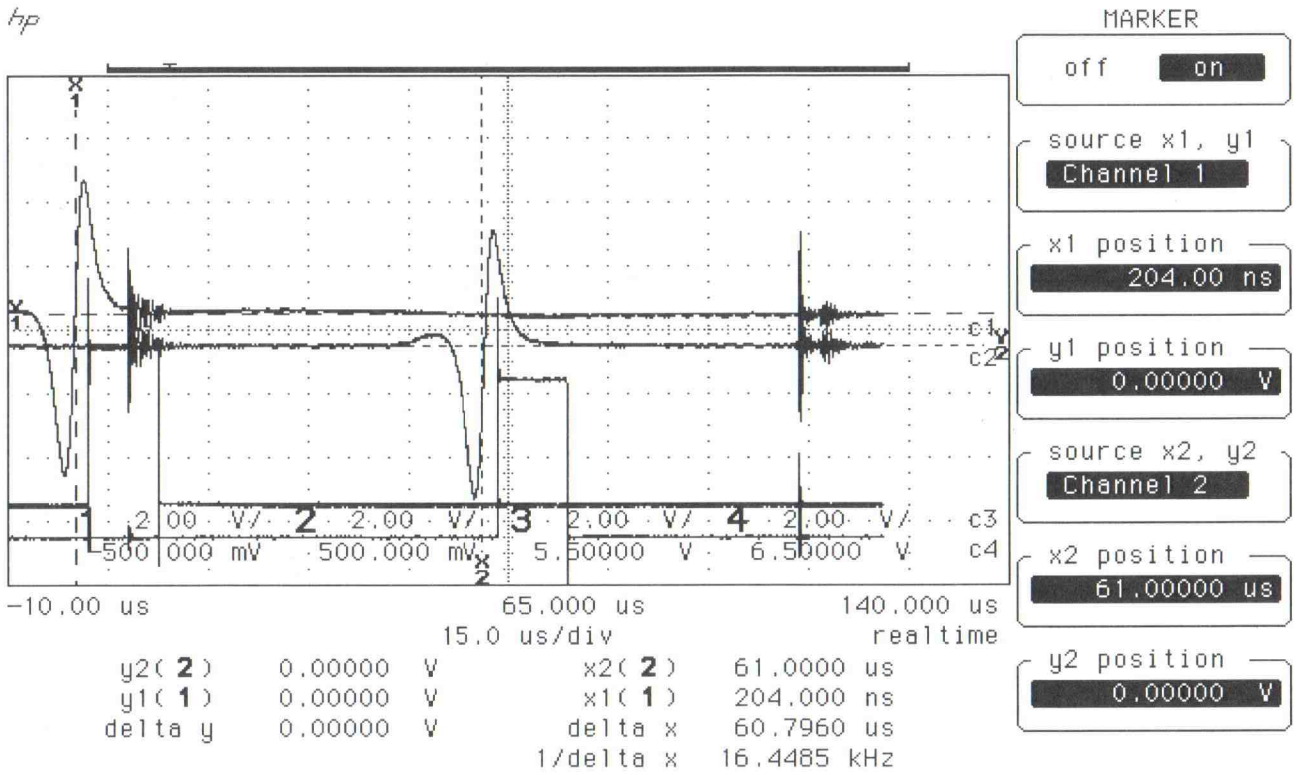
Shot #457 Xray #1 5/22/12



HP6
#457

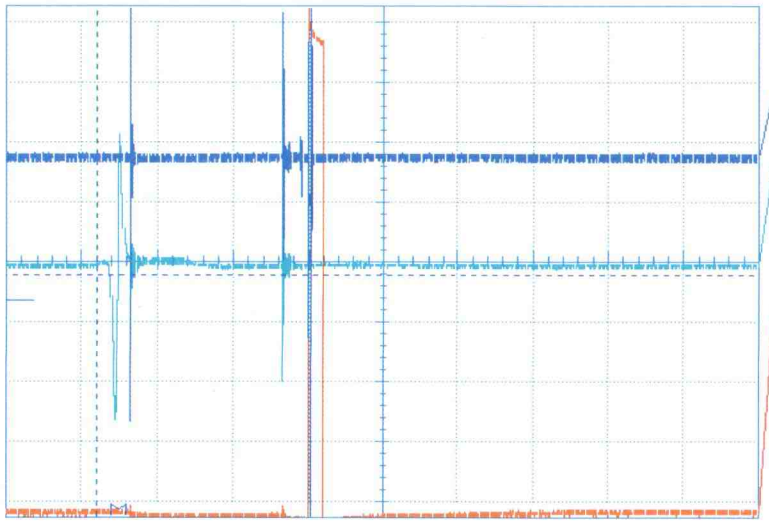

hp
MARKER
off
on
source x1, y1
Channel 4
x1 position
108.62580 us
y1 position
24.3750 V
source x2, y2
Channel 3
x2 position
8.09900 us
y2 position
26.2500 V
c2
c1
c4
c3
1 2.00 V/ 2 5.00 V/ 3 5.00 V/ 4 5.00 V/
0.00000 V 12.5000 V 18.7500 V 16.2500 V
-8.000 us
67.000 us
142.000 us
15.0 us/div
realtime
y2(3) 26.2500 V
y1(4) 24.3750 V
delta y 1.87500 V
x2(3) 8.09900 us
x1(4) 108.626 us
delta x -100.527 us
1/delta x 9.94760 kHz

HPS
#457


hp
MARKER
off
on
source x1, y1
Channel 1
x1 position
204.00 ns
y1 position
0.00000 V
source x2, y2
Channel 2
x2 position
61.00000 us
y2 position
0.00000 V
2.00 V/
2.00 V/
2.00 V/
2.00 V/
500.000 mV
500.000 mV
5.50000 V
6.50000 V
c1
c2
c3
c4
-10.00 us
65.000 us
140.000 us
15.0 us/div
realtime
y2(2) 0.00000 V
y1(1) 0.00000 V
delta y 0.00000 V
x2(2) 61.0000 us
x1(1) 204.000 ns
delta x 60.7960 us
1/delta x 16.4485 kHz

GS7
#457

PRINTED : May-22-2012:16.28.01
PRODUCT : Classic 6500 S/N 84900024



TRC4M:
(May-22-2012:15.49.43)
100mV/div,50µs/div
TRC1M:
(May-22-2012:15.49.43)
2V/div,50µs/div
TRC3M:
(May-22-2012:15.49.43)
5V/div,50µs/div

TR4M
CURSOR :TRC2 -14.6V
+201.3mV
950µs
CURSOR :TRC1 -73.3mV
+141.5mV
950µs
CURSOR :TRC3 +40.5mV
+141.3mV
950µs
CURSOR :TRC4 -83.3mV
+141.3mV
950µs

LIGHT GAS GUN DATA SHEET

Shot No. 458 Date 5/31/2012

Target:

Sample Material Forsterite #30 Crystallographic orientation –

Source Location Morion Created Gems Thickness:1 – in.

Type of Measurement Pre-heated EOS 2000°C 2. – in.

Bulk Density – gm/cc Crystal Density – gm/cc

±2 std. devs. – gm/cc ±2 std. devs. – gm/cc

Total Shorting Pin Height – in. Driver Plate Thickness . in.
(shim to driver) Material Mo

Projectile:

Weight 20.1340 gms. Length 0.9050 in. Skirt Diameter 1.1135 in.

Flyer Plate Material Mo Leading Edge Dia. 1.1006 in.

Thickness 0.0609 in. Major Dia. 0.9830 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. Pressure 120 Temp. 21.0°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.6 in. O-ring Groove Depth .111 in.

Diameter: Front 3.500 in. Back 3.498 in.

Pump Tube:

Pre-Fill Pressure -28.8 in. Hg Fill Pressure 170 psig.

Powder Charge:

Main Charge 518 gms. Type IMR 4350 Total Charge 530 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 4.500 km/sec Piston 0.560 km/sec

Notes:

10 turn magnet - intervalometer set @ 0.3

L.G.G.

147.8950 1

Camera Streak Duration: 1515 nsec Timing calibration frequency: ~~[illegible]~~ MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 3.424 µsec Flash X-ray #2 81.900 µsec

Static Streak Photo _____ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0551 in. min. 0.0937 in. min.

0.0564 in. max. 0.0943 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 72 / 85 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____ cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.560 km/sec

Piston Velocity from Gauge #1 to #3: 0.555 km/sec

Projectile Velocity from UDC: 4518 m/sec

Projectile Velocity from X-ray: ~~[illegible]~~ km/sec

~4526 m/s (back edge of projectile estimate)

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL		
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	544	µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1098	µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	45.100	µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	85.181	µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	86.216	µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	1040	µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	85.170	µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	45.07	µsec
UDC Velocity:			4517.78	M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	36.20	ns
HP5, 2:	Velocity magnet 2	45.109	µsec
HP5, 3:	TTL Start	2.0400	µsec
HP5, 4:	TTL Stop	47.1036	µsec
HP6, 1:	Velocity Magnet 1	18.70	ns
HP6,2:	Xenon Lamp Trigger	85.4694	µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	6.04450	µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	91.21360	µsec
GS7, 1:	Velocity Magnet 1	15.090	µsec
GS7,3:	Camera Trigger (UDC HV 1)	106.890	µsec
GS7, 4:	Camera Monitor Out	107.1075	µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	45.700 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	85.801 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	87.472 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	1.675 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	85.817 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	45.690 µsec
UDC Velocity:			445.72 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	299.8 ns
HP5, 2:	Velocity magnet 2	46.009 6 µsec
HP5, 3:	TTL Start	2.310 64 ~~48.0029~~ µsec
HP5, 4:	TTL Stop	48.004 2 µsec
HP6, 1:	Velocity Magnet 1	284.0 ns
HP6,2:	Xenon Lamp Trigger	87.0168 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	6.282 8 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	92.098 4 µsec
GS7, 1:	Velocity Magnet 1	15.329 5 µsec
GS7, 2:	Camera Cal. Sig.	109.047 6 µsec
GS7,3:	Camera Trigger (UDC HV 1)	108.372 5 µsec
GS7, 4:	Camera Monitor Out	108.587 5 µsec

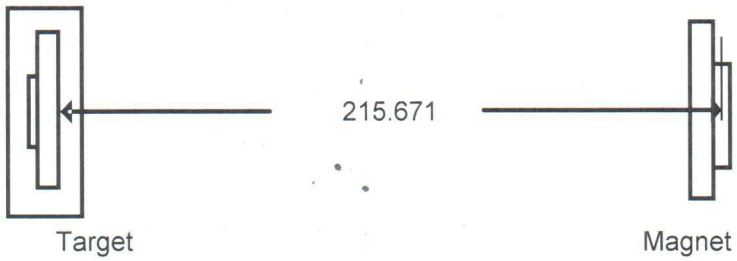
MAGNET DISTANCE

Shot No. **458** Expected Velocity: **4.50**

DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement =	8.016	inch
Distance Between Magnet # 1 to Magnet # 2 =	203.606	mm
TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 =	**45.246 µsec.**	

DISTANCE BETWEEN MAGNET # 2 TO TARGET



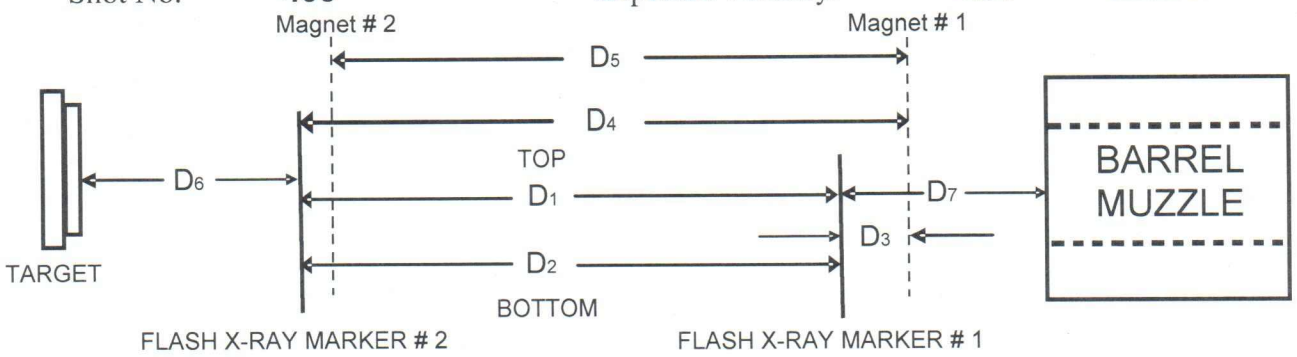
Micrometer Measurement

First measurement =	8.367	inch
Second measurement =	8.365	inch
Average measurement =	8.366	inch
Average measurement =	212.496	mm
Center line of the thickness of Magnet # 2 =	3.175	mm
Distance Between Magnet # 2 to Target =	215.671	mm
TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET =	**47.927 µsec.**	
Fudged Distance between Magnet 2 to Target =	0	mm

0.201764

TARGET MEASUREMENT

Shot No. **458** Expected Velocity: **4.50** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	0.0	99.0
Measure # 2, mm	30.00	383.15	203.66	0.0	99.0
Average, mm	30.00	383.15	203.61	0.0	99.0
Travel time, µsec	**6.67**	**85.14**	**45.25**	**0.00**	**22.00**

Top

D_1, Flash X-Ray fiducial distance 1:	353.19	mm
D_1, Flash X-Ray fiducial distance 2:	353.24	mm
Average:	353.22	mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **78.49** µsec.

Bottom

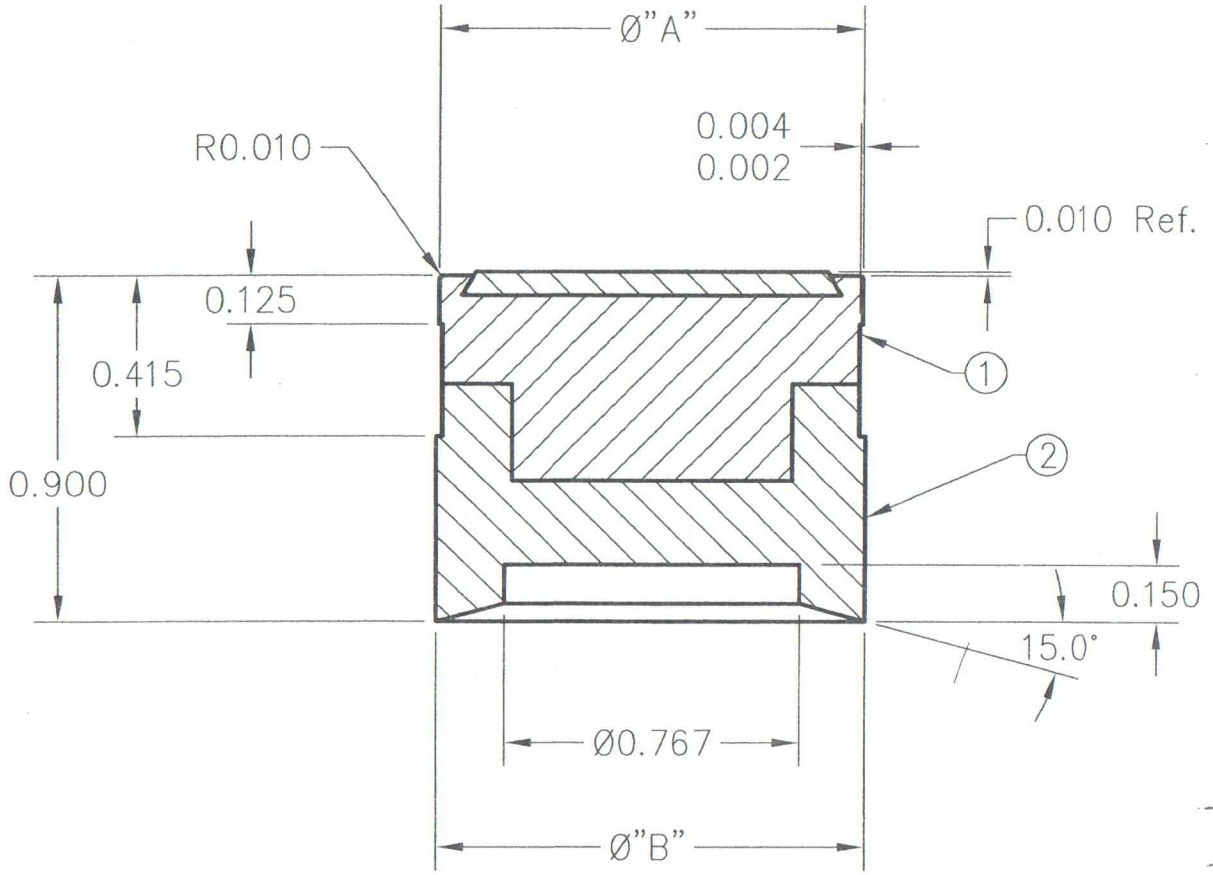
D_2, Flash X-Ray fiducial distance 1:	353.09	mm
D_2, Flash X-Ray fiducial distance 2:	353.06	mm
Average:	353.08	mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **78.46** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **3.57** µsec. 3.424

Flash X-Ray # 2 Delay (from Magnet # 1) **82.49** µsec. 81.900



SHOT # 458

BUILT AS

SHOT#		
A	1.1009	+.0000 −.0005
B	1.1128	+.0005 −.0000

1.1006

1.1135

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−128	1
1	Sabot & Flyer Plate	LGG−157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH 16

DRAWN M. Long DATE 11/29/10
ENGINEER DATE
APPROVED DATE

MATERIAL Zelux−M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE
Projectile Assy.
for 28mm launch tube (GM)

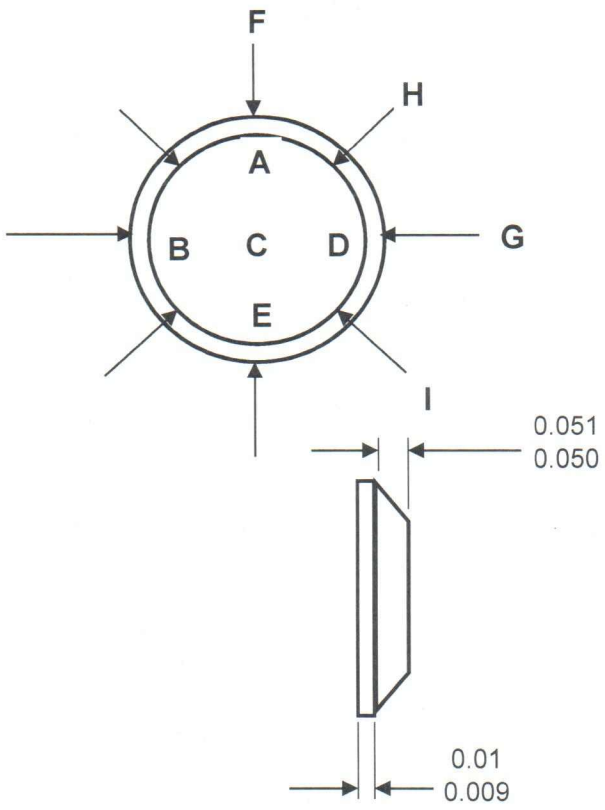
SCALE 2:1 | SHEET 2 of 2 | A | DRAWING NUMBER LGG−158

SHOT No. **458**

FLYER PLATE MATERIAL: **molybdenum (6-1.55mm) - GM-LT**

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06080	F	0.98250
A	0.06090	F	0.98350
B	0.06095	G	0.98300
B	0.06100	G	0.98300
C	0.06100	H	0.92700
C	0.06100	H	0.92700
D	0.06100	I	0.92700
D	0.06085	I	0.92700
E	0.06105		
E	0.06100		



Statistic for thickness

N	10
MAX	0.06105
MIN	0.06080
Range	0.00025
MEAN	0.06096
STDEV	7.97566E-05

Statistic for Diameter (F-G)

N	4
MAX	0.98350
MIN	0.98250
Range	0.00100
MEAN	0.9830000
STDEV	0.000408248

Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927
STDEV	0

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1			7.2068			10.232
2			7.2066			10.222
3			7.2066			10.224
	THICKNESS		0.060955	±	in	
	FLATNESS:		0.00025	in.		
	VOLUME:		0.7581	1.48E-03	cm^3	
	CRYSTAL DENSITY:		10.2260	5.29E-03	$grams/cm^3$	
	BULK DENSITY:		9.5066	1.48E-03	$grams/cm^3$	

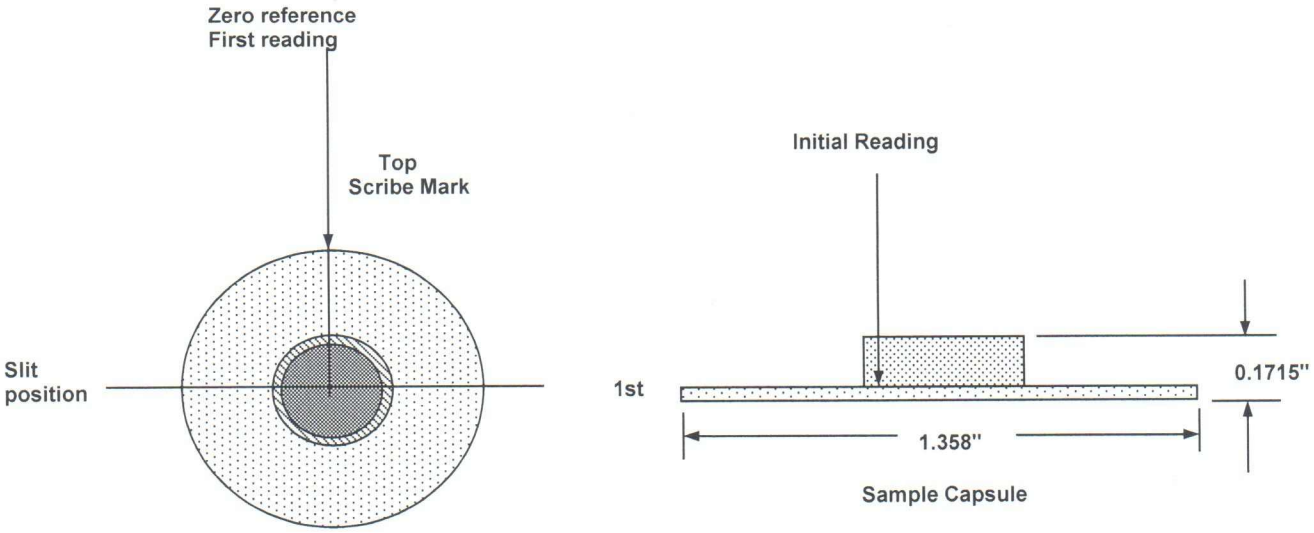
DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED BY: _____ on _____

SAMPLE CAPSULE: **30**
SAMPLE MATERIAL: **Molybdenum**

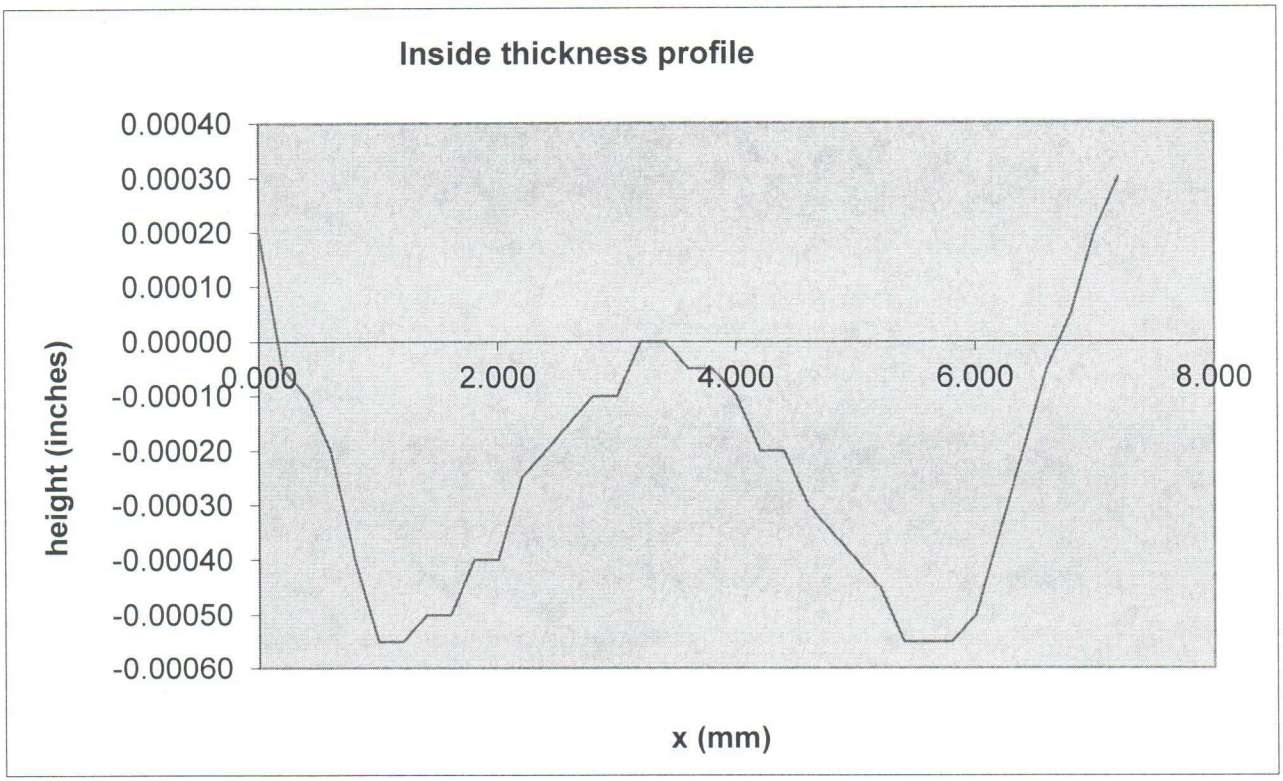
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.683
4.623



Average thickness reading = -0.00023

Note: The thickness of the reference zero point from the base is = **0.04265** Inches
1.08331 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

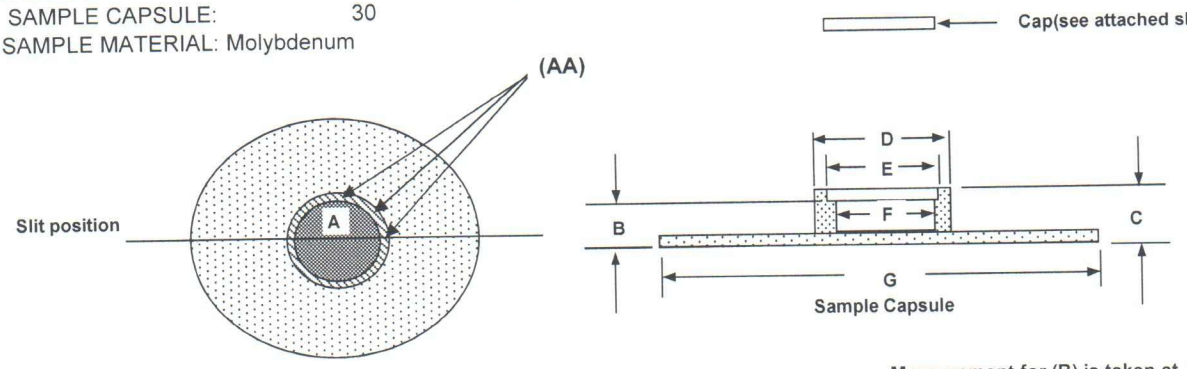
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00020	3.6	south
2	0.200	-0.00005	3.40	
3	0.400	-0.00010	3.20	
4	0.600	-0.00020	3.00	
5	0.800	-0.00040	2.80	
6	1.000	-0.00055	2.60	
7	1.200	-0.00055	2.40	
8	1.400	-0.00050	2.20	
9	1.600	-0.00050	2.00	
10	1.800	-0.00040	1.80	
11	2.000	-0.00040	1.60	
12	2.200	-0.00025	1.40	
13	2.400	-0.00020	1.20	
14	2.600	-0.00015	1.00	
15	2.800	-0.00010	0.80	
16	3.000	-0.00010	0.60	
17	3.200	0.00000	0.40	
18	3.400	0.00000	0.20	
19	3.600	-0.00005	0.00	
20	3.800	-0.00005	-0.20	
21	4.000	-0.00010	-0.40	
22	4.200	-0.00020	-0.60	
23	4.400	-0.00020	-0.80	
24	4.600	-0.00030	-1.00	
25	4.800	-0.00035	-1.20	
26	5.000	-0.00040	-1.40	
27	5.200	-0.00045	-1.60	
28	5.400	-0.00055	-1.80	
29	5.600	-0.00055	-2.00	
30	5.800	-0.00055	-2.20	
31	6.000	-0.00050	-2.40	
32	6.200	-0.00035	-2.60	
33	6.400	-0.00020	-2.80	
34	6.600	-0.00005	-3.00	
35	6.800	0.00005	-3.20	
36	7.000	0.00020	-3.40	
37	7.200	0.00030	-3.60	north

11/18/2010

SHOT No.: prepolish

SAMPLE CAPSULE: 30

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE
THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04060
A	0.04080
A	0.04065
A	0.04060
Avg	0.04066

DIGITAL CALIFER
DIAMETER MEASUREMENT

E	0.3535
E	0.3530
F	0.3140
F	0.3140

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17135
C	0.17140
C	0.17140
C	0.17150
D	0.3960
D	0.3960
G	1.3595
G	1.3590
H	0.10171

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14270
B point 2	0.14275
B point 3	0.14270
B point 4	0.14215
B point 5	0.14220
B point 6	0.14220
B point 7	0.14210
B point 8	0.14215

Statistics

N	8
MAX	0.14275
MIN	0.14210
Range	0.00065
Average	0.14237

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SHOT No. _____

LGG Moly Capsule Cap

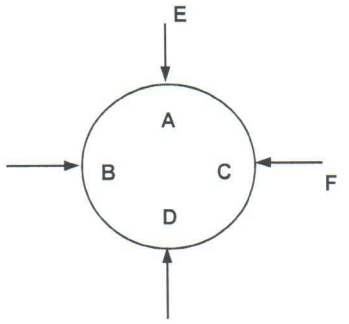
SAMPLE MATERIAL: Mo 30

11/18/2010

Post polish

Thickness Measurement

A	0.03095
A	0.03100
B	0.03085
B	0.03085
C	0.03095
C	0.03085
D	0.03100
D	0.03100



Diameter Measurement

E	0.35350
E	0.35350
F	0.35400
F	0.35350
AVE	0.35363
Radius	0.1768

Statistic for thickness

N	8
MAX	0.03100
MIN	0.0309
Range	0.00015
MEAN	0.03093
STDEV	7.03943E-05

Statistic for perimeter

N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.353625
STDEV	0.00025

post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03093125	±	mm	
	FLATNESS:		0.00015			
	VOLUME:		0.0498		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		9.9888		$grams/cm^3$	

SHOT No. _____ tip used: .7mm long/ flat tip

SAMPLE CAPSULE: 30 note: the platform on which the measurement was taken

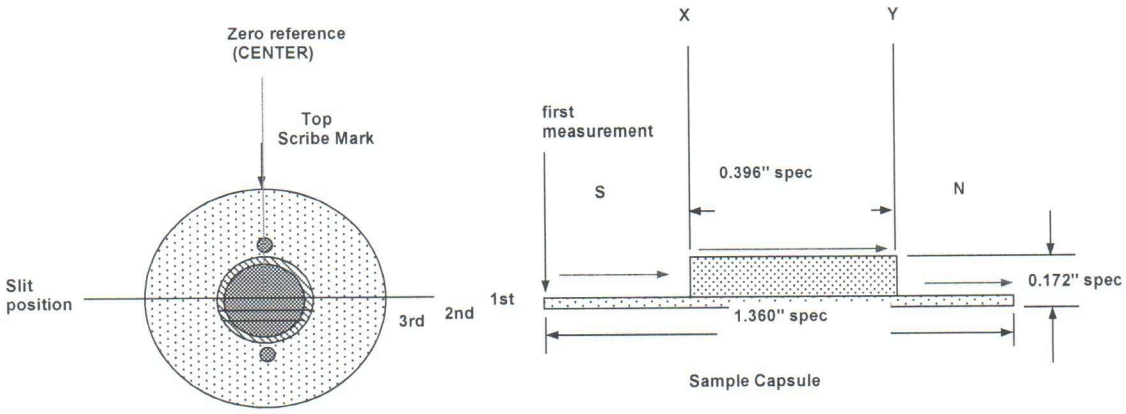
SAMPLE MATERIAL: deviates from flat by +0.013 max.

direction of measurement

4.849

1.792

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00009

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00000

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

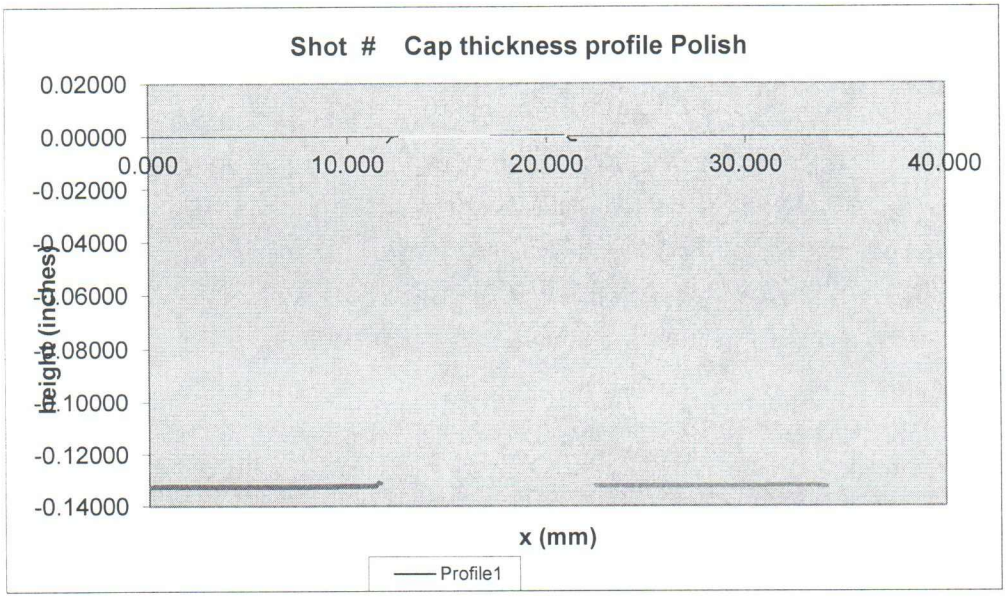
Average thickness reading = 0.00000

Note: Measurement from reference zero point from the base is = **0.1731** Inches
4.3955 mm

Average thickness of the driver Plate = 0.0405 Inches
1.0295 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm



1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Be
3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s
1	0.000	17.000	-0.13305	225	22.400	-5.400	-0.13225
2	0.100	16.900	-0.13295	226	22.500	-5.500	-0.13230
3	0.200	16.800	-0.13285	227	22.600	-5.600	-0.13235
4	0.300	16.700	-0.13285	228	22.700	-5.700	-0.13230
5	0.400	16.600	-0.13280	229	22.800	-5.800	-0.13230
6	0.500	16.500	-0.13280	230	22.900	-5.900	-0.13230
7	0.600	16.400	-0.13270	231	23.000	-6.000	-0.13230
8	0.700	16.300	-0.13270	232	23.100	-6.100	-0.13230
9	0.800	16.200	-0.13270	233	23.200	-6.200	-0.13230
10	0.900	16.100	-0.13270	234	23.300	-6.300	-0.13235
11	1.000	16.000	-0.13265	235	23.400	-6.400	-0.13235
12	1.100	15.900	-0.13270	236	23.500	-6.500	-0.13235
13	1.200	15.800	-0.13265	237	23.600	-6.600	-0.13235
14	1.300	15.700	-0.13270	238	23.700	-6.700	-0.13235
15	1.400	15.600	-0.13270	239	23.800	-6.800	-0.13240
16	1.500	15.500	-0.13275	240	23.900	-6.900	-0.13240
17	1.600	15.400	-0.13275	241	24.000	-7.000	-0.13240
18	1.700	15.300	-0.13275	242	24.100	-7.100	-0.13240
19	1.800	15.200	-0.13270	243	24.200	-7.200	-0.13240
20	1.900	15.100	-0.13270	244	24.300	-7.300	-0.13240
21	2.000	15.000	-0.13275	245	24.400	-7.400	-0.13240
22	2.100	14.900	-0.13275	246	24.500	-7.500	-0.13240
23	2.200	14.800	-0.13275	247	24.600	-7.600	-0.13240
24	2.300	14.700	-0.13275	248	24.700	-7.700	-0.13240
25	2.400	14.600	-0.13275	249	24.800	-7.800	-0.13240
26	2.500	14.500	-0.13280	250	24.900	-7.900	-0.13240
27	2.600	14.400	-0.13275	251	25.000	-8.000	-0.13240
28	2.700	14.300	-0.13275	252	25.100	-8.100	-0.13240
29	2.800	14.200	-0.13280	253	25.200	-8.200	-0.13240
30	2.900	14.100	-0.13280	254	25.300	-8.300	-0.13240
31	3.000	14.000	-0.13280	255	25.400	-8.400	-0.13240
32	3.100	13.900	-0.13280	256	25.500	-8.500	-0.13240
33	3.200	13.800	-0.13280	257	25.600	-8.600	-0.13240
34	3.300	13.700	-0.13280	258	25.700	-8.700	-0.13240
35	3.400	13.600	-0.13280	259	25.800	-8.800	-0.13240
36	3.500	13.500	-0.13280	260	25.900	-8.900	-0.13240
37	3.600	13.400	-0.13280	261	26.000	-9.000	-0.13240
38	3.700	13.300	-0.13285	262	26.100	-9.100	-0.13240
39	3.800	13.200	-0.13280	263	26.200	-9.200	-0.13245
40	3.900	13.100	-0.13285	264	26.300	-9.300	-0.13240
41	4.000	13.000	-0.13285	265	26.400	-9.400	-0.13245
42	4.100	12.900	-0.13280	266	26.500	-9.500	-0.13245
43	4.200	12.800	-0.13285	267	26.600	-9.600	-0.13240
44	4.300	12.700	-0.13285	268	26.700	-9.700	-0.13245
45	4.400	12.600	-0.13285	269	26.800	-9.800	-0.13245
46	4.500	12.500	-0.13285	270	26.900	-9.900	-0.13245
47	4.600	12.400	-0.13285	271	27.000	-10.000	-0.13245
48	4.700	12.300	-0.13285	272	27.100	-10.100	-0.13245
49	4.800	12.200	-0.13280	273	27.200	-10.200	-0.13245
50	4.900	12.100	-0.13285	274	27.300	-10.300	-0.13245
51	5.000	12.000	-0.13280	275	27.400	-10.400	-0.13245
52	5.100	11.900	-0.13280	276	27.500	-10.500	-0.13245
53	5.200	11.800	-0.13280	277	27.600	-10.600	-0.13245
54	5.300	11.700	-0.13280	278	27.700	-10.700	-0.13245
55	5.400	11.600	-0.13285	279	27.800	-10.800	-0.13245
56	5.500	11.500	-0.13285	280	27.900	-10.900	-0.13245
57	5.600	11.400	-0.13280	281	28.000	-11.000	-0.13245
58	5.700	11.300	-0.13280	282	28.100	-11.100	-0.13240
59	5.800	11.200	-0.13280	283	28.200	-11.200	-0.13240
60	5.900	11.100	-0.13285	284	28.300	-11.300	-0.13240
61	6.000	11.000	-0.13280	285	28.400	-11.400	-0.13245
62	6.100	10.900	-0.13280	286	28.500	-11.500	-0.13240
63	6.200	10.800	-0.13280	287	28.600	-11.600	-0.13240
64	6.300	10.700	-0.13280	288	28.700	-11.700	-0.13240
65	6.400	10.600	-0.13280	289	28.800	-11.800	-0.13240
66	6.500	10.500	-0.13280	290	28.900	-11.900	-0.13240
67	6.600	10.400	-0.13280	291	29.000	-12.000	-0.13240
68	6.700	10.300	-0.13280	292	29.100	-12.100	-0.13240
69	6.800	10.200	-0.13280	293	29.200	-12.200	-0.13240
70	6.900	10.100	-0.13280	294	29.300	-12.300	-0.13240
71	7.000	10.000	-0.13280	295	29.400	-12.400	-0.13240
72	7.100	9.900	-0.13275	296	29.500	-12.500	-0.13240
73	7.200	9.800	-0.13280	297	29.600	-12.600	-0.13235

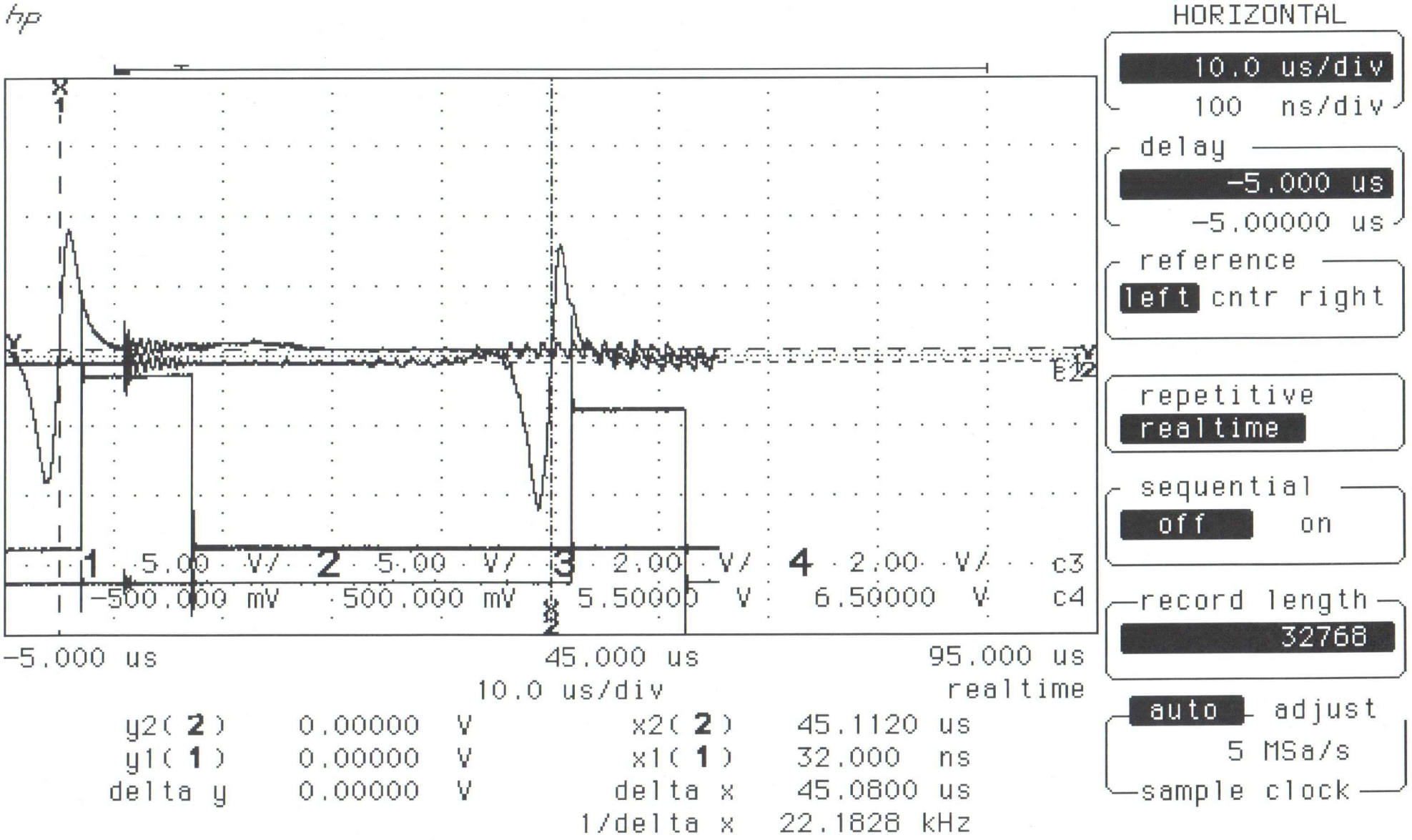
74	7.300	9.700	-0.13280	298	29.700	-12.700	-0.13240
75	7.400	9.600	-0.13275	299	29.800	-12.800	-0.13235
76	7.500	9.500	-0.13275	300	29.900	-12.900	-0.13235
77	7.600	9.400	-0.13275	301	30.000	-13.000	-0.13235
78	7.700	9.300	-0.13270	302	30.100	-13.100	-0.13235
79	7.800	9.200	-0.13275	303	30.200	-13.200	-0.13235
80	7.900	9.100	-0.13275	304	30.300	-13.300	-0.13230
81	8.000	9.000	-0.13270	305	30.400	-13.400	-0.13230
82	8.100	8.900	-0.13270	306	30.500	-13.500	-0.13230
83	8.200	8.800	-0.13270	307	30.600	-13.600	-0.13230
84	8.300	8.700	-0.13270	308	30.700	-13.700	-0.13230
85	8.400	8.600	-0.13270	309	30.800	-13.800	-0.13230
86	8.500	8.500	-0.13265	310	30.900	-13.900	-0.13230
87	8.600	8.400	-0.13270	311	31.000	-14.000	-0.13225
88	8.700	8.300	-0.13270	312	31.100	-14.100	-0.13225
89	8.800	8.200	-0.13270	313	31.200	-14.200	-0.13225
90	8.900	8.100	-0.13265	314	31.300	-14.300	-0.13225
91	9.000	8.000	-0.13265	315	31.400	-14.400	-0.13220
92	9.100	7.900	-0.13265	316	31.500	-14.500	-0.13220
93	9.200	7.800	-0.13260	317	31.600	-14.600	-0.13220
94	9.300	7.700	-0.13265	318	31.700	-14.700	-0.13220
95	9.400	7.600	-0.13265	319	31.800	-14.800	-0.13220
96	9.500	7.500	-0.13260	320	31.900	-14.900	-0.13215
97	9.600	7.400	-0.13260	321	32.000	-15.000	-0.13215
98	9.700	7.300	-0.13260	322	32.100	-15.100	-0.13215
99	9.800	7.200	-0.13260	323	32.200	-15.200	-0.13215
100	9.900	7.100	-0.13260	324	32.300	-15.300	-0.13215
101	10.000	7.000	-0.13260	325	32.400	-15.400	-0.13215
102	10.100	6.900	-0.13260	326	32.500	-15.500	-0.13215
103	10.200	6.800	-0.13255	327	32.600	-15.600	-0.13215
104	10.300	6.700	-0.13255	328	32.700	-15.700	-0.13215
105	10.400	6.600	-0.13255	329	32.800	-15.800	-0.13215
106	10.500	6.500	-0.13250	330	32.900	-15.900	-0.13210
107	10.600	6.400	-0.13250	331	33.000	-16.000	-0.13215
108	10.700	6.300	-0.13250	332	33.100	-16.100	-0.13215
109	10.800	6.200	-0.13245	333	33.200	-16.200	-0.13215
110	10.900	6.100	-0.13250	334	33.300	-16.300	-0.13215
111	11.000	6.000	-0.13250	335	33.400	-16.400	-0.13215
112	11.100	5.900	-0.13245	336	33.500	-16.500	-0.13225
113	11.200	5.800	-0.13250	337	33.600	-16.600	-0.13230
114	11.300	5.700	-0.13250	338	33.700	-16.700	-0.13235
115	11.400	5.600	-0.13200	339	33.800	-16.800	-0.13240
116	11.500	5.500	-0.13075	340	33.900	-16.900	-0.13255
117	11.600	5.400	-0.13130	341	34.000	-17.000	-0.13260

elow the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm	1st	2nd	3 rd
118	11.700	5.300	Run	Run	Run
119	11.800	5.200	Reading	Reading	Reading
120	11.900	5.100	Inches	Inches	Inches
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	-0.00225		
125	12.400	4.600	-0.00150		
126	12.500	4.500	-0.00030	0.00000	
127	12.600	4.400	-0.00015	0.00000	
128	12.700	4.300	-0.00010	0.00000	
129	12.800	4.200	-0.00005	0.00000	
130	12.900	4.100	-0.00005	0.00000	0.00000
131	13.000	4.000	-0.00005	0.00000	0.00000
132	13.100	3.900	-0.00005	0.00000	0.00000
133	13.200	3.800	-0.00005	0.00000	0.00000
134	13.300	3.700	-0.00005	0.00000	0.00000
135	13.400	3.600	0.00000	0.00000	0.00000
136	13.500	3.500	-0.00005	0.00000	0.00000
137	13.600	3.400	-0.00005	0.00000	0.00000
138	13.700	3.300	-0.00005	0.00000	0.00000
139	13.800	3.200	0.00000	0.00000	0.00000
140	13.900	3.100	0.00000	0.00000	0.00000
141	14.000	3.000	0.00000	0.00000	0.00000
142	14.100	2.900	0.00000	0.00000	0.00000
143	14.200	2.800	-0.00005	0.00000	0.00000
144	14.300	2.700	-0.00005	0.00000	0.00000
145	14.400	2.600	-0.00005	0.00000	0.00000
146	14.500	2.500	-0.00005	0.00000	0.00000
147	14.600	2.400	-0.00005	0.00000	0.00000
148	14.700	2.300	-0.00005	0.00000	0.00000
149	14.800	2.200	-0.00005	0.00000	0.00000
150	14.900	2.100	-0.00005	0.00000	0.00000
151	15.000	2.000	-0.00005	0.00000	0.00000
152	15.100	1.900	-0.00005	0.00000	0.00000
153	15.200	1.800	-0.00005	0.00000	0.00000
154	15.300	1.700	-0.00005	0.00000	0.00000
155	15.400	1.600	-0.00005	0.00000	0.00000
156	15.500	1.500	-0.00005	0.00000	0.00000
157	15.600	1.400	-0.00005	0.00000	0.00000
158	15.700	1.300	-0.00010	0.00000	0.00000
159	15.800	1.200	-0.00005	0.00000	0.00000
160	15.900	1.100	-0.00005	0.00000	0.00000
161	16.000	1.000	-0.00005	0.00000	0.00000
162	16.100	0.900	-0.00005	0.00000	0.00000
163	16.200	0.800	-0.00005	0.00000	0.00000
164	16.300	0.700	-0.00005	0.00000	0.00000
165	16.400	0.600	0.00000	0.00000	0.00000
166	16.500	0.500	-0.00005	0.00000	0.00000
167	16.600	0.400	-0.00005	0.00000	0.00000
168	16.700	0.300	0.00000	0.00000	0.00000
169	16.800	0.200	-0.00005	0.00000	0.00000
170	16.900	0.100	-0.00005	0.00000	0.00000
171	17.000	0.000	0.00000	0.00000	0.00000
172	17.100	-0.100	-0.00005	0.00000	0.00000
173	17.200	-0.200	0.00000	0.00000	0.00000
174	17.300	-0.300	0.00000	0.00000	0.00000
175	17.400	-0.400	0.00000	0.00000	0.00000
176	17.500	-0.500	0.00005	0.00000	0.00000
177	17.600	-0.600	0.00005	0.00000	0.00000
178	17.700	-0.700	0.00005	0.00000	0.00000
179	17.800	-0.800	0.00005	0.00000	0.00000
180	17.900	-0.900	0.00005	0.00000	0.00000
181	18.000	-1.000	0.00005	0.00000	0.00000
182	18.100	-1.100	0.00005	0.00000	0.00000
183	18.200	-1.200	0.00005	0.00000	0.00000
184	18.300	-1.300	0.00005	0.00000	0.00000
185	18.400	-1.400	0.00010	0.00000	0.00000
186	18.500	-1.500	0.00010	0.00000	0.00000
187	18.600	-1.600	0.00010	0.00000	0.00000
188	18.700	-1.700	0.00010	0.00000	0.00000
189	18.800	-1.800	0.00010	0.00000	0.00000
190	18.900	-1.900	0.00010	0.00000	0.00000

191	19.000	-2.000	0.00010	0.00000	0.00000
192	19.100	-2.100	0.00010	0.00000	0.00000
193	19.200	-2.200	0.00010	0.00000	0.00000
194	19.300	-2.300	0.00010	0.00000	0.00000
195	19.400	-2.400	0.00015	0.00000	0.00000
196	19.500	-2.500	0.00015	0.00000	0.00000
197	19.600	-2.600	0.00015	0.00000	0.00000
198	19.700	-2.700	0.00015	0.00000	0.00000
199	19.800	-2.800	0.00015	0.00000	0.00000
200	19.900	-2.900	0.00015	0.00000	0.00000
201	20.000	-3.000	0.00015	0.00000	0.00000
202	20.100	-3.100	0.00015	0.00000	0.00000
203	20.200	-3.200	0.00015	0.00000	0.00000
204	20.300	-3.300	0.00015	0.00000	0.00000
205	20.400	-3.400	0.00015	0.00000	0.00000
206	20.500	-3.500	0.00020	0.00000	0.00000
207	20.600	-3.600	0.00020	0.00000	0.00000
208	20.700	-3.700	0.00020	0.00000	0.00000
209	20.800	-3.800	0.00020	0.00000	0.00000
210	20.900	-3.900	0.00020	0.00000	0.00000
211	21.000	-4.000	0.00020	0.00000	0.00000
212	21.100	-4.100	0.00015	0.00000	0.00000
213	21.200	-4.200	0.00010	0.00000	0.00000
214	21.300	-4.300	-0.00010	0.00000	0.00000
215	21.400	-4.400	-0.00075	0.00000	
216	21.500	-4.500	-0.00145	0.00000	
217	21.600	-4.600	-0.00165	0.00000	
218	21.700	-4.700	-0.00165		
219	21.800	-4.800	-0.00160		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

HPS LGG shot #458 10-turn magnets



Shot 458 Nominal Timeline Preshot

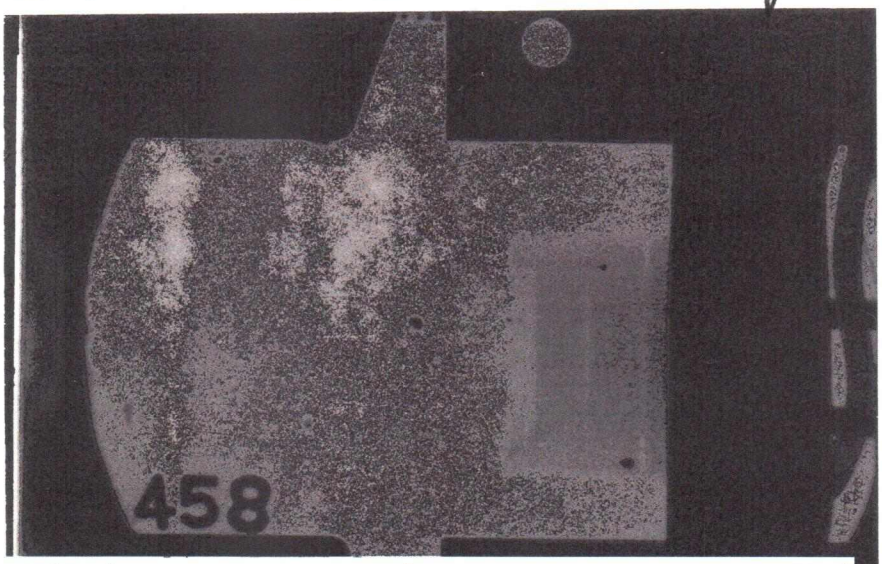
V	4500				meters	mag SIM time	45246	ns				rho0	Co	s					
cable time	90	150		M1-M2 distance	0.203606						Cold Mo	10206	5033	1.28946405					
intervalometer intrinsic delay	2080	2080		M2-target distance	0.215671						Hot Mo	9785	4857.9	1.2875	2000 C				
UDC extra count lag	123			M2-target fudge	0.201764						Liquid Forsterit	2653.62	3772.0	1.431415					
pulse translator delay	150			M1-fid1 distance	0.03														
X-ray 1 program delay	3424	3424	X-ray 1 actual delay	M1-fid2 distance	0.383145														
X-ray 2 program delay	81900	81900	X-ray 2 actual delay	Flyer thickness	0.00154686												up	P	Us
X-ray 1 pulser delay	600										driver	562.0825943	-217343780	4.97646E+11	2303.39353	176.331996	7823.51917		
X-ray 2 pulser delay	625			Us(Mo)	7823.51917						sample	8799.754822	-173618278	4.86346E+11	3380.42554	77.2417477	8610.7672		
Camera intrinsic delay	107			driver thickness	0.0010287						cap	-8799.75482	-108905219	2.41295E+11	1918.3007	137.545351	7327.71215		
Lamp trigger to peak brightness	7127			cap thickness	0.00078562														
HV#3 delay to lamp	-6370			estimated sample+cover time	222.725308														
Streak duration	1514																		
Desired dead streak before driver	500																		

t (ns)	flyer x (m)	shock front (m)	event
0	0.00077343		M1 zero-crossing
150	0.00144843		HP5-1, GS7-1, HP6-1, Intervalometer start
2230	0.01080843		HP5-3, UDC start, signal to pulse translator
2380	0.01148343		pulse translator out
5804	0.02689143		X-ray 1 delay amp out to counters 4, 5
6494	0.02999643		X-ray 1 fires
6584	0.03040143		X-ray 1 pulse monitor at counter 4b
45246	0.20437943		M2 zero-crossing
45396	0.20505443		HP5-2, Intervalometer stop
47476	0.21441443		HP5-4, UDC stop
84280	0.38003343		X-ray 2 delay amp, stop counter 4, start counter 6
84995	0.38325093		X-ray 2 fires
85085	0.38365593		X-ray 2 pulse monitor at counter 4b
92435	0.4167322		UDC out, GS7-3, stop counters 5 and 6
92525	0.4171372		Trigger at camera
92632	0.4176187		Begin Streak
92722	0.4180237		Camera Monitor on GS7-4
93001	0.419277	0	IMPACT
93132		0.0010287	Driver arrival on streak
93355		0.002771196	Sample cutoff on streak
94146		0.008961748	End Streak

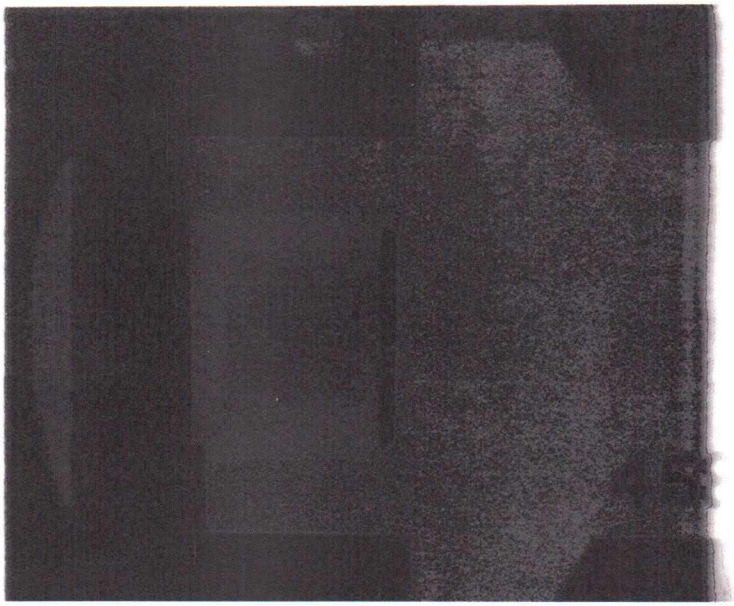
								X-ray velocity	4500										
									On film										
						X-ray 1 flyer vs. fid (mm)		-0.00357	-0.0041512										
												scopes							
											triq	GS7-1		0	10V pp	rising			
											sim only	GS7-2		92935	10 V _-_	ttl			
												GS7-3		92285	40 V _-_				
						Counter 3:	45246					GS7-4		92572	(-)1.75 V	down going			
								HP5 2-1	45246		triq	HP5-1		0	10V pp	rising			
						UDC upcount:	45246	HP5 4-3	45246			HP5-2		45246	10V pp	rising			
						Counter 4:	78476					HP5-3		2080	5 V _-_				
						X-ray 2 flyer vs. fid (mm)		0.10593	0.12317442			HP5-4		47326	5 V _-_				
						Counter 4b:	78501				triq	HP6-1		0	10V pp	rising			
						Counter 5:	86631	GS7 3-1	92285		HV#1-14.3us	HP6-2		86065	10 V _-_				
						Counter 6:	8155	GS7 4-1	92572			HP6-3		6434	25 V /\				
												HP6-4		84935	25 V /\				
								HP6-1											

Driver cutoff on streak	500
Sample cutoff on sreak	723

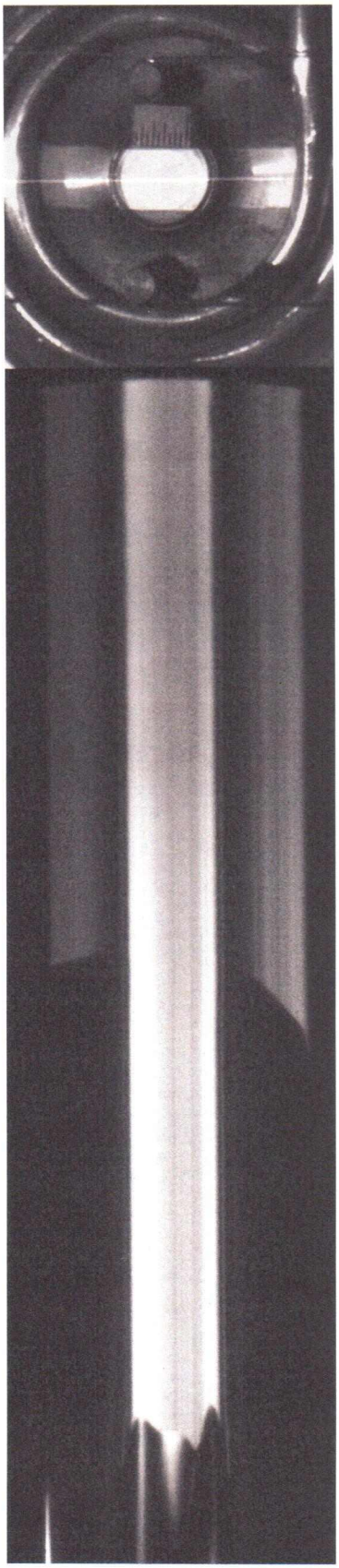
5/31/2012 LGG shot #458 X-ray #2



5/31/2012 LGG shot #458 X-ray #1



SHOT #458



LIGHT GAS GUN DATA SHEET

6/8/12

Shot No. 459 Date ~~6/4/2012~~

Target:

Sample Material Forsterite Single XTL (#29) Crystallographic orientation _____

Source Location Morion Created Gems Thickness:1 _____ in.

Type of Measurement Pre-heated EOS 2000°C 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in. Material _____

Projectile:

Weight 20.405 gms. Length 0.8970 in. Skirt Diameter 1.1130 in.

Flyer Plate Material Mo Leading Edge Dia. 1.1009 in.

Thickness 0.06099 in. Major Dia. 0.9840 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. ~~Pressure~~ FORCE 120 POUNDS TEMP. 22°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth .111 in.

Diameter: Front 3.495 in. Back 3.497 in.

Pump Tube:

Pre-Fill Pressure _____ in. Hg Fill Pressure _____ psig.

Powder Charge:

Main Charge 748 gms. Type IMR 4350 Total Charge 760.06 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 6.00 km/sec Piston _____ km/sec

Notes:

L.G.G.

Camera Streak Duration: 1515 nsec Timing calibration frequency: 147.89501 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 25 px/mm

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 1.7 µsec Flash X-ray #2 60.6 µsec

Static Streak Photo _____ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0556 in. min. 0.0930 in. min.

0.0564 in. max. 0.0932 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 108/83 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____ cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	427 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	857 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	34.2 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	58.248 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	65.458 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.214 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	58.260 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	34.170 µsec
UDC Velocity:			5957.90 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	59.60 ns
HP5, 2:	Velocity magnet 2	34.2092 µsec
HP5, 3:	TTL Start	2.1083 µsec
HP5, 4:	TTL Stop	36.2894 µsec
HP6, 1:	Velocity Magnet 1	52.0 ns
HP6,2:	Xenon Lamp Trigger	63.1581 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	4.4799 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	62.7386 µsec
GS7, 1:	Velocity Magnet 1	15.03025 µsec
GS7,3:	Camera Trigger (UDC HV 1)	84.4985 µsec
GS7, 4:	Camera Monitor Out	84.7395 µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL		
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	~~59.518~~ 34.400	µsec 33.800
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	59.518	µsec 58.560
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	~~6.071~~ 65.584	µsec 64.721
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	~~59.584~~ 6.071	µsec 6.166
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	59.584	µsec 58.592
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	34.240	µsec 33.800
UDC Velocity:			5947.14	M/sec 6023.29

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	305.0 ns	310.80
HP5, 2:	Velocity magnet 2	34.554 6 µsec	34.0948
HP5, 3:	TTL Start	2.310 µsec	2312
HP5, 4:	TTL Stop	36.547 2 µsec	36.0980
HP6, 1:	Velocity Magnet 1	268.90 ns	276.10
HP6,2:	Xenon Lamp Trigger	63.495 8 µsec	62.61
HP6, 3:	X-ray 1 Pulser Monitor Out	4.630 4 µsec	4.6168
HP6, 4:	X-ray 2 Pulser Monitor Out	64.211 0 µsec	63.208
GS7, 1:	Velocity Magnet 1	15.1727 µsec	
GS7, 2:	Camera Cal. Sig.	85.3875 µsec	
GS7,3:	Camera Trigger (UDC HV 1)	84.7085 µsec	
GS7, 4:	Camera Monitor Out	84.950 µsec	

Shot 459 Nominal Timeline Preshot

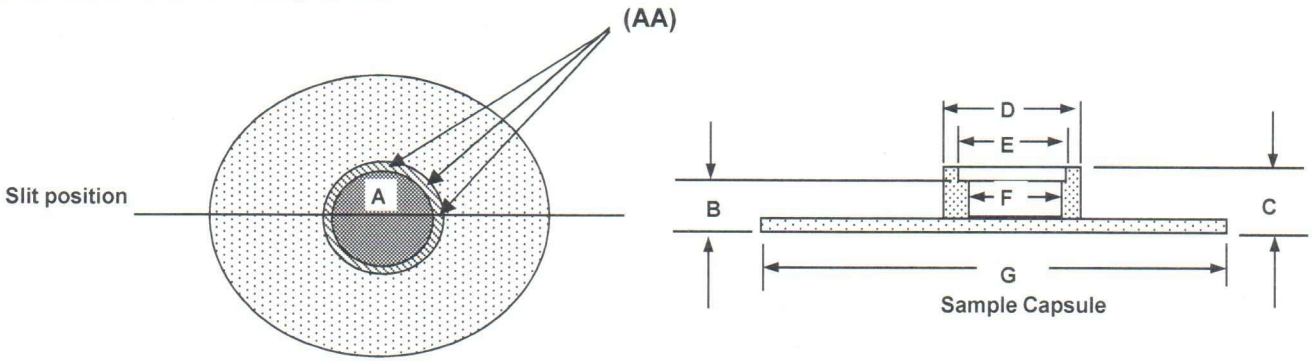
| | | |

SHOT No.: ~~458~~ 459 prepolish 11/18/2010

SAMPLE CAPSULE: 29

SAMPLE MATERIAL: Molybdenum

Cap(see attached sheet)



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

	inside
A	0.04135
A	0.04140
A	0.04145
A	0.04140
Avg	0.04140

C	0.17200
C	0.17205
C	0.17205
C	0.17215
D	0.3965
D	0.3965

B point 1(top)	0.14230
B point 2	0.14225
B point 3	0.14220
B point 4	0.14215
B point 5	0.14215
B point 6	0.14225
B point 7	0.14225
B point 8	0.14230

Statistics

N	8
MAX	0.14230
MIN	0.14215
Range	0.00015
Average	0.14223

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3515
E	0.3535
F	0.3145
F	0.3150

G	1.3590
G	1.3590
H	0.10083

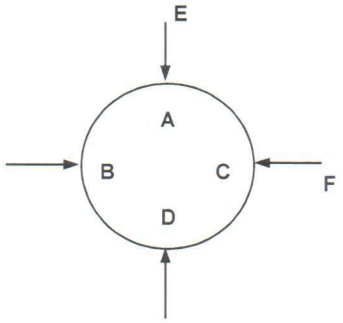
MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SHOT No. _ ~~458~~ 459
LGG Moly Capsule Cap
SAMPLE MATERIAL: Mo 29

11/18/2010

Post polish

Thickness Measurement	
A	0.03055
A	0.03065
B	0.03065
B	0.03055
C	0.03060
C	0.03060
D	0.03060
D	0.03065



Diameter Measurement	
E	0.35400
E	0.35350
F	0.35400
F	0.35350
AVE	0.35375
Radius	0.1769

Statistic for thickness	
N	8
MAX	0.03065
MIN	0.0306
Range	1E-04
MEAN	0.03061
STDEV	4.17261E-05

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.35375
STDEV	0.000288675

post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03060625	±	mm	
	FLATNESS:		1E-04			
	VOLUME:		0.0493		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.0877		$grams/cm^3$	

MAGNET DISTANCE

Shot No. **459** Expected Velocity: **6.00**

DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement =	8.016 inch
Distance Between Magnet # 1 to Magnet # 2 =	203.606 mm
TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 =	**33.934 µsec.**

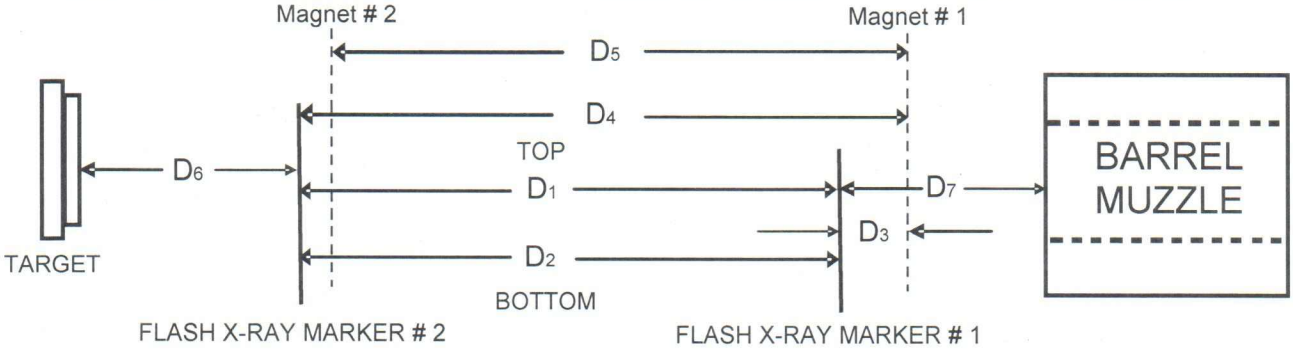
DISTANCE BETWEEN MAGNET # 2 TO TARGET

Micrometer Measurement

First measurement =	8.375 inch
Second measurement =	8.377 inch
Average measurement =	8.376 inch
Average measurement =	212.750 mm
Center line of the thickness of Magnet # 2 =	3.175 mm
Distance Between Magnet # 2 to Target =	215.925 mm
TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET =	**35.988 µsec.**
Fudged Distance between Magnet 2 to Target =	0 mm 0.197564 m

TARGET MEASUREMENT

Shot No. **459** Expected Velocity: **6.00** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	8.375	99.0
Measure # 2, mm	30.00	383.15	203.66	8.377	99.0
Average, mm	30.00	383.15	203.61	8.376	99.0
Travel time, µsec	**5.00**	**63.86**	**33.93**	**1.40**	**16.50**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **58.87** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **58.85** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **1.90** µsec. 1.800

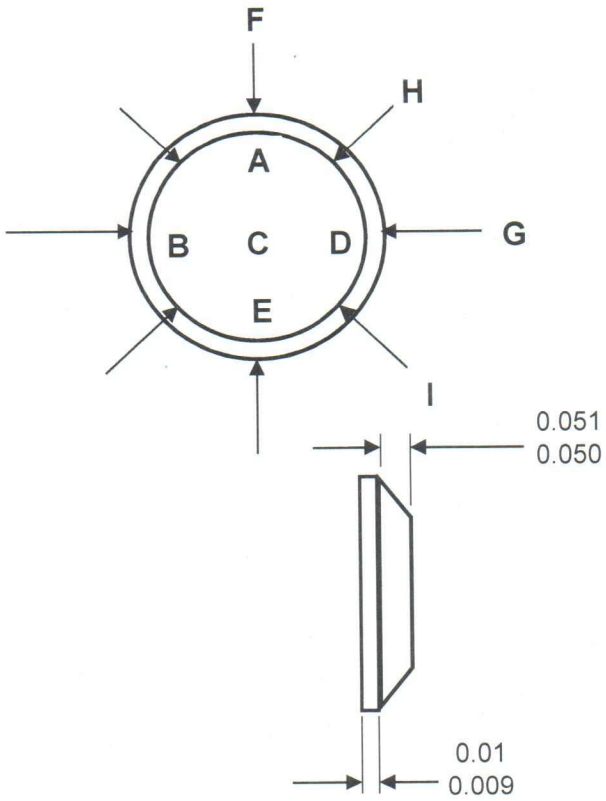
Flash X-Ray # 2 Delay (from Magnet # 1) **61.21** µsec. 60.657

SHOT No.

FLYER PLATE MATERIAL: **molybdenum (7-1.55mm) - GM-LT**

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06100	F	0.98350
A	0.06105	F	0.98400
B	0.06095	G	0.98400
B	0.06100	G	0.98450
C	0.06100	H	0.92700
C	0.06100	H	0.92700
D	0.06100	I	0.92700
D	0.06095	I	0.92700
E	0.06100		
E	0.06095		



Statistic for thickness

N	10
MAX	0.06105
MIN	0.06095
Range	0.00010
MEAN	0.06099
STDEV	3.16228E-05

Statistic for Diameter (F-G)

N	4
MAX	0.98450
MIN	0.98350
Range	0.00100
MEAN	0.9840000
STDEV	0.000408248

Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927
STDEV	0

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1			7.2291			10.229
2			7.2288			10.222
3			7.2290			10.231
	THICKNESS		0.06099	±	in	
	FLATNESS:		0.00010	in.		
	VOLUME:		0.7600	1.47E-03	cm^3	
	CRYSTAL DENSITY:		10.2273	4.73E-03	$grams/cm^3$	
	BULK DENSITY:		9.5112	1.48E-03	$grams/cm^3$	

DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED BY: _____ on _____

1 PROCESSING FILE lgg459

FINAL SUMMARY FOR RUN NUMBER 1, CONFIGURATION 1

shot 459 6/5/12

INITIAL CONDITIONS

CHARGE WEIGHT	760.06	GRAMS	1.6756 LBS
BURNING RATE	1314.29	G/S/BAR^N	0.446838LB/S/PSI^N
PISTON WEIGHT	2267.96	GRAMS	5.0000 LBS
PISTON RELEASE PRESSURE	34.47	BARS	500. PSI
INITIAL RESERVOIR PRESSURE	12.76	BARS	185. PSI
PROJECTILE WEIGHT	20.02	GRAMS	0.0441 LBS
PROJECTILE RELEASE PRESSURE	275.79	BARS	4000. PSI
WEIGHT SUM THRU PROJECTILE	3088.32	GRAMS	6.8086 LBS

DIMENSIONS

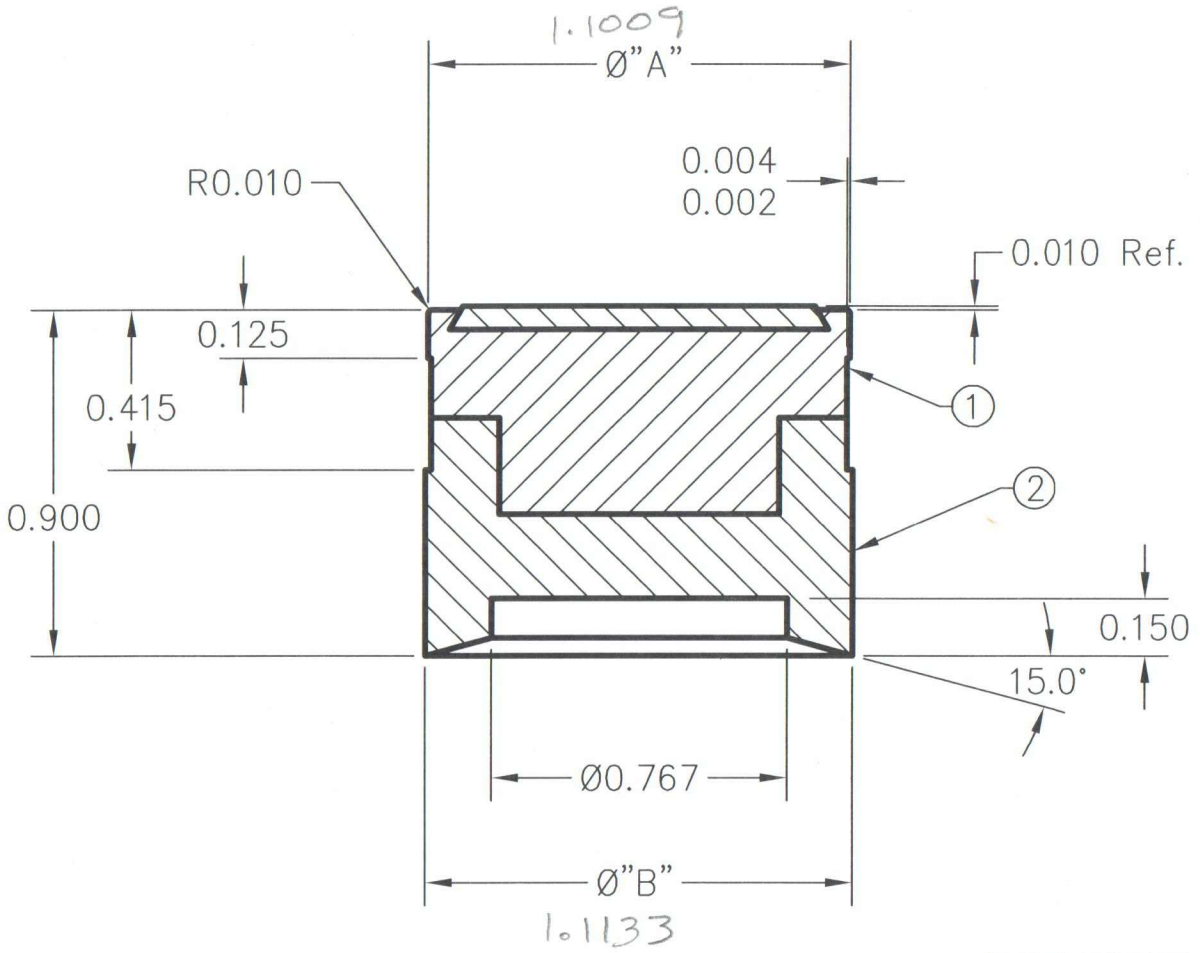
POWDER CHAMBER VOLUME	5947.23	CC	362.9224 CU IN
VOLUME OF RESERVOIR	39372.41	CC	2402.6522 CU IN
VOLUME OF TAPER	536.47	CC	32.7376 CU IN
ANGLE OF TAPER	9.423	DEG	
SLOPE OF TAPER	0.165968		
POWDER CHAMBER DIAMETER	12.065	CM	4.750 IN
PUMP TUBE DIAMETER	8.890	CM	3.500 IN
LAUNCH TUBE DIAMETER	2.819	CM	1.110 IN
LAUNCH TUBE LENGTH	583.681	CM	19.150 FT
TOTAL GUN LENGTH	1350.00	CM	44.291 FT
AREA RATIO	9.9460		

PISTON VELOCITIES

START TO STATION 1	0.3490	KM/SEC	1145.0 FT/SEC
STATION 1 TO STATION 2	0.7182	KM/SEC	2356.1 FT/SEC
STATION 2 TO STATION 3	0.7176	KM/SEC	2354.5 FT/SEC
STATION 3 TO STATION 4	0.6330	KM/SEC	2076.7 FT/SEC

1

RESULTS



Note: Super Glue & Press Fit 1 & 2

		SHOT# 459	
Built As 1.1009	A	1.1009	+.0000 −.0005
1.1130	B	1.1128	+.0005 −.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG−128	1
1	Sabot & Flyer Plate	LGG−157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

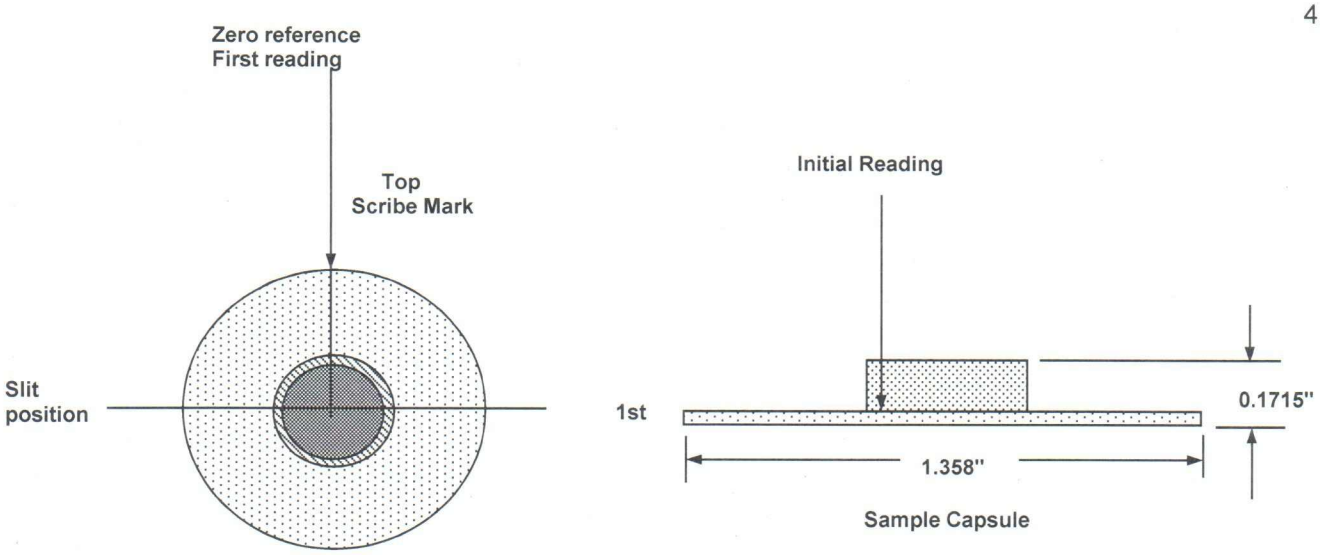
UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN M. Long	DATE 11/29/10	CALIFORNIA INSTITUTE of TECHNOLOGY SHOCK WAVE LABORATORY	
ENGINEER	DATE	TITLE Projectile Assy. for 28mm launch tube (GM)	
APPROVED	DATE		
FINISH 16	MATERIAL Zelux−M&HDP	SCALE 2:1	SHEET 2 of 2
		A	DRAWING NUMBER LGG−158

SAMPLE CAPSULE: **29**
SAMPLE MATERIAL: **Molybdenum**

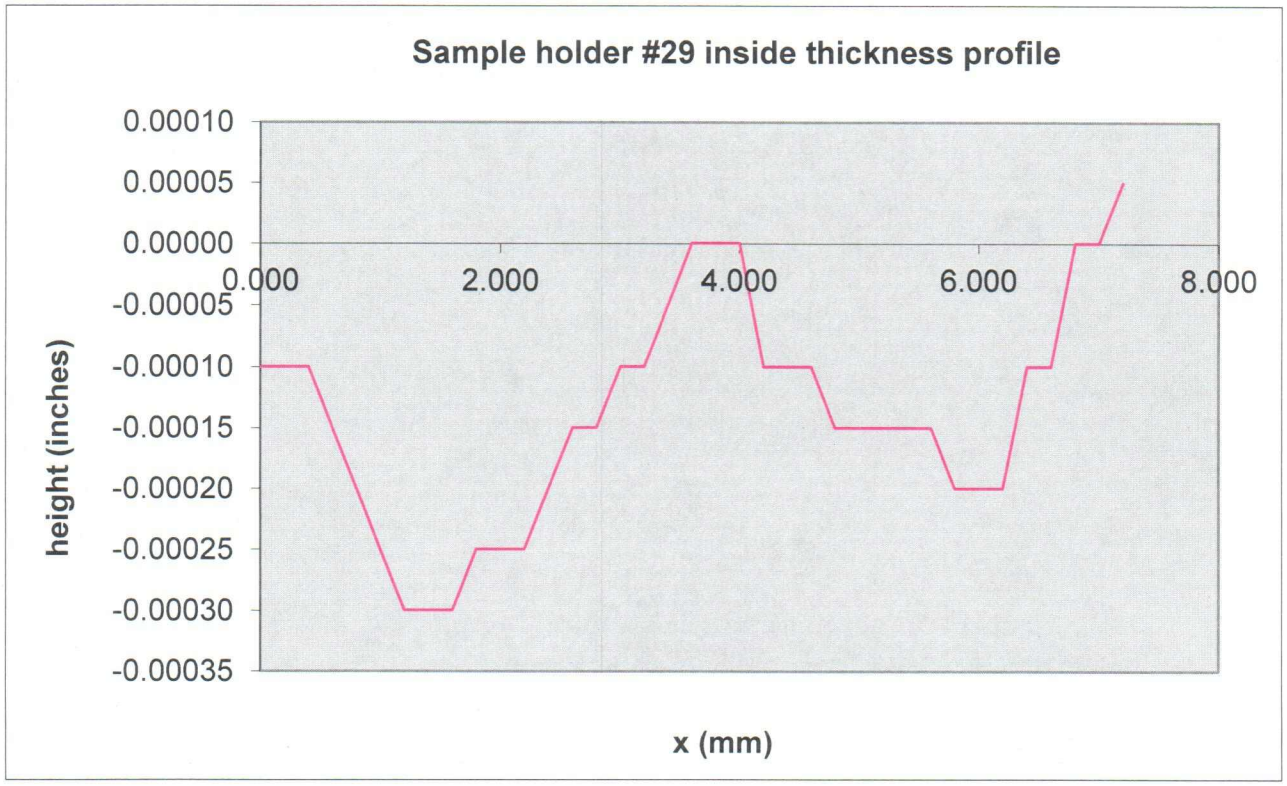
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.683
4.623



Average thickness reading = -0.00014

Note: The thickness of the reference zero point from the base is = **0.04285** Inches
1.08839 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	-0.00010	3.6	south
2	0.200	-0.00010	3.40	
3	0.400	-0.00010	3.20	
4	0.600	-0.00015	3.00	
5	0.800	-0.00020	2.80	
6	1.000	-0.00025	2.60	
7	1.200	-0.00030	2.40	
8	1.400	-0.00030	2.20	
9	1.600	-0.00030	2.00	
10	1.800	-0.00025	1.80	
11	2.000	-0.00025	1.60	
12	2.200	-0.00025	1.40	
13	2.400	-0.00020	1.20	
14	2.600	-0.00015	1.00	
15	2.800	-0.00015	0.80	
16	3.000	-0.00010	0.60	
17	3.200	-0.00010	0.40	
18	3.400	-0.00005	0.20	
19	3.600	0.00000	0.00	
20	3.800	0.00000	-0.20	
21	4.000	0.00000	-0.40	
22	4.200	-0.00010	-0.60	
23	4.400	-0.00010	-0.80	
24	4.600	-0.00010	-1.00	
25	4.800	-0.00015	-1.20	
26	5.000	-0.00015	-1.40	
27	5.200	-0.00015	-1.60	
28	5.400	-0.00015	-1.80	
29	5.600	-0.00015	-2.00	
30	5.800	-0.00020	-2.20	
31	6.000	-0.00020	-2.40	
32	6.200	-0.00020	-2.60	
33	6.400	-0.00010	-2.80	
34	6.600	-0.00010	-3.00	
35	6.800	0.00000	-3.20	
36	7.000	0.00000	-3.40	
37	7.200	0.00005	-3.60	north

SHOT No. ~~458~~ 459 tip used: .7mm long/ flat tip

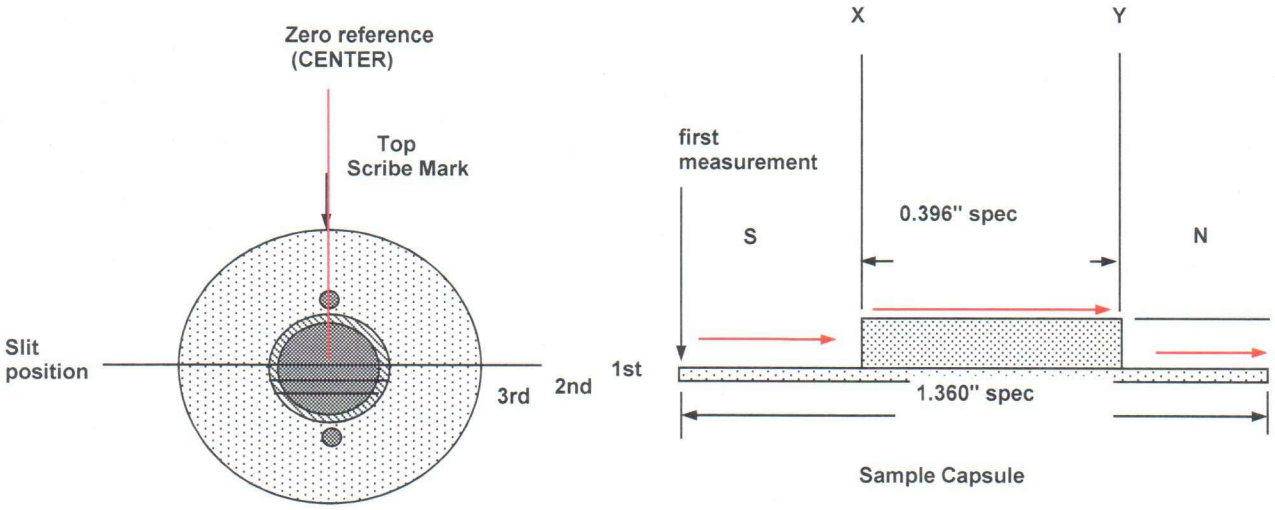
SAMPLE CAPSULE: 29 note: the platform on which the measu

SAMPLE MATERIAL: deviates from flat by +0.013 max.

direction of measurement

0.127

THICKNESS PROFILE (Not re-polished, but final surface) 0.0885



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = -0.00006

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = -0.00007

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

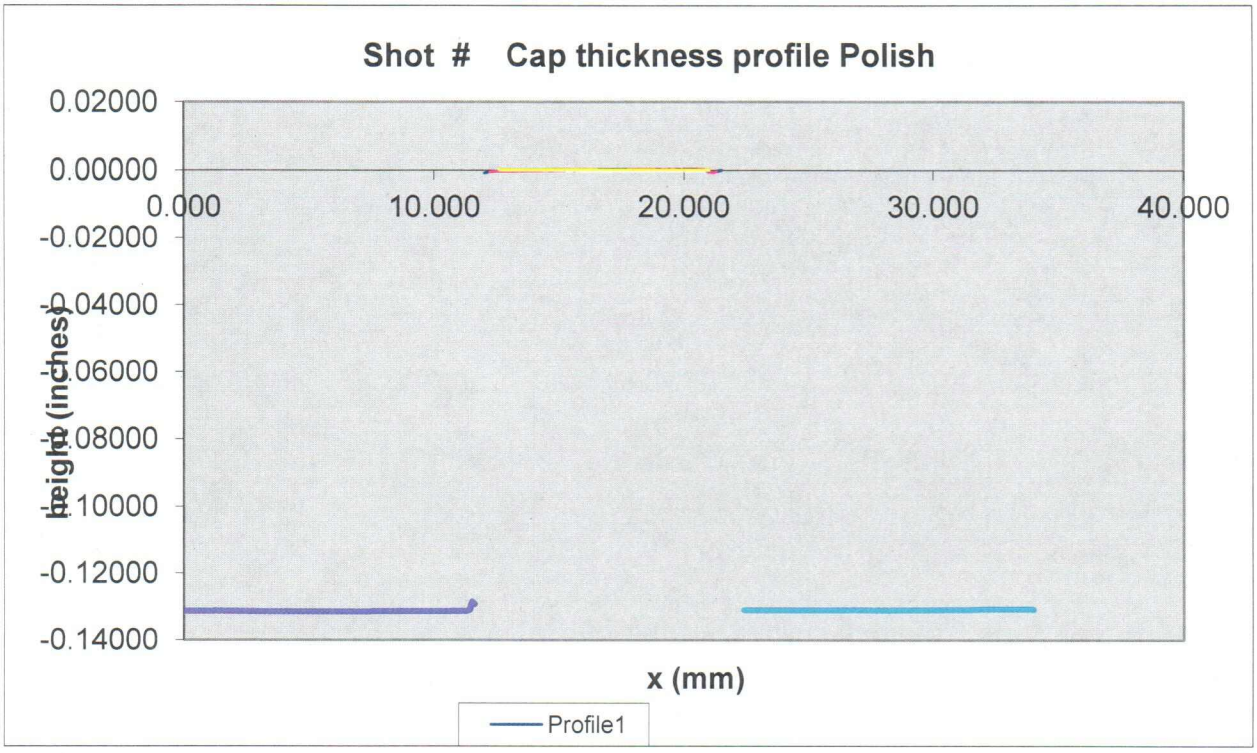
Average thickness reading = 0.00000

Note: Measurement from reference zero point from the base is = **0.1725**
4.3802

Average thickness of the driver Plate = 0.0412
1.0462

Thickness of the Carbon Deposited on the coil side is =

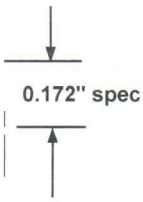
Thickness of the C Deposited on the Projectile side is =


Shot # Cap thickness profile Polish
0.02000
0.00000
-0.02000
-0.04000
-0.06000
-0.08000
-0.10000
-0.12000
-0.14000
0.000
10.000
20.000
30.000
40.000
Height (inches)
x (mm)
Profile1

rement was taken

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Bel
3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s
1	0.000	17.000	-0.13160	225	22.400	-5.400	-0.13120
2	0.100	16.900	-0.13150	226	22.500	-5.500	-0.13120
3	0.200	16.800	-0.13150	227	22.600	-5.600	-0.13120
4	0.300	16.700	-0.13145	228	22.700	-5.700	-0.13120
5	0.400	16.600	-0.13145	229	22.800	-5.800	-0.13115
6	0.500	16.500	-0.13150	230	22.900	-5.900	-0.13120
7	0.600	16.400	-0.13150	231	23.000	-6.000	-0.13120
8	0.700	16.300	-0.13145	232	23.100	-6.100	-0.13120
9	0.800	16.200	-0.13145	233	23.200	-6.200	-0.13115
10	0.900	16.100	-0.13145	234	23.300	-6.300	-0.13115
11	1.000	16.000	-0.13150	235	23.400	-6.400	-0.13115
12	1.100	15.900	-0.13145	236	23.500	-6.500	-0.13115
13	1.200	15.800	-0.13140	237	23.600	-6.600	-0.13120
14	1.300	15.700	-0.13140	238	23.700	-6.700	-0.13120
15	1.400	15.600	-0.13145	239	23.800	-6.800	-0.13120
16	1.500	15.500	-0.13140	240	23.900	-6.900	-0.13120
17	1.600	15.400	-0.13145	241	24.000	-7.000	-0.13120
18	1.700	15.300	-0.13150	242	24.100	-7.100	-0.13115
19	1.800	15.200	-0.13145	243	24.200	-7.200	-0.13115
20	1.900	15.100	-0.13145	244	24.300	-7.300	-0.13115
21	2.000	15.000	-0.13145	245	24.400	-7.400	-0.13115
22	2.100	14.900	-0.13145	246	24.500	-7.500	-0.13115
23	2.200	14.800	-0.13145	247	24.600	-7.600	-0.13115
24	2.300	14.700	-0.13145	248	24.700	-7.700	-0.13120
25	2.400	14.600	-0.13150	249	24.800	-7.800	-0.13120
26	2.500	14.500	-0.13150	250	24.900	-7.900	-0.13115
27	2.600	14.400	-0.13155	251	25.000	-8.000	-0.13120
28	2.700	14.300	-0.13150	252	25.100	-8.100	-0.13120
29	2.800	14.200	-0.13150	253	25.200	-8.200	-0.13120
30	2.900	14.100	-0.13160	254	25.300	-8.300	-0.13120
31	3.000	14.000	-0.13155	255	25.400	-8.400	-0.13115
32	3.100	13.900	-0.13155	256	25.500	-8.500	-0.13120
33	3.200	13.800	-0.13155	257	25.600	-8.600	-0.13120
34	3.300	13.700	-0.13155	258	25.700	-8.700	-0.13115
35	3.400	13.600	-0.13155	259	25.800	-8.800	-0.13115
36	3.500	13.500	-0.13155	260	25.900	-8.900	-0.13115
37	3.600	13.400	-0.13155	261	26.000	-9.000	-0.13120
38	3.700	13.300	-0.13155	262	26.100	-9.100	-0.13120
39	3.800	13.200	-0.13155	263	26.200	-9.200	-0.13120
40	3.900	13.100	-0.13155	264	26.300	-9.300	-0.13115
41	4.000	13.000	-0.13155	265	26.400	-9.400	-0.13115
42	4.100	12.900	-0.13155	266	26.500	-9.500	-0.13115
43	4.200	12.800	-0.13155	267	26.600	-9.600	-0.13115
44	4.300	12.700	-0.13155	268	26.700	-9.700	-0.13115
45	4.400	12.600	-0.13155	269	26.800	-9.800	-0.13110
46	4.500	12.500	-0.13155	270	26.900	-9.900	-0.13120
47	4.600	12.400	-0.13160	271	27.000	-10.000	-0.13115
48	4.700	12.300	-0.13160	272	27.100	-10.100	-0.13110
49	4.800	12.200	-0.13160	273	27.200	-10.200	-0.13115
50	4.900	12.100	-0.13155	274	27.300	-10.300	-0.13115
51	5.000	12.000	-0.13160	275	27.400	-10.400	-0.13115
52	5.100	11.900	-0.13155	276	27.500	-10.500	-0.13115
53	5.200	11.800	-0.13155	277	27.600	-10.600	-0.13115
54	5.300	11.700	-0.13155	278	27.700	-10.700	-0.13115
55	5.400	11.600	-0.13155	279	27.800	-10.800	-0.13110
56	5.500	11.500	-0.13155	280	27.900	-10.900	-0.13115
57	5.600	11.400	-0.13155	281	28.000	-11.000	-0.13110



Inches
mm

Inches
mm

nm

nm

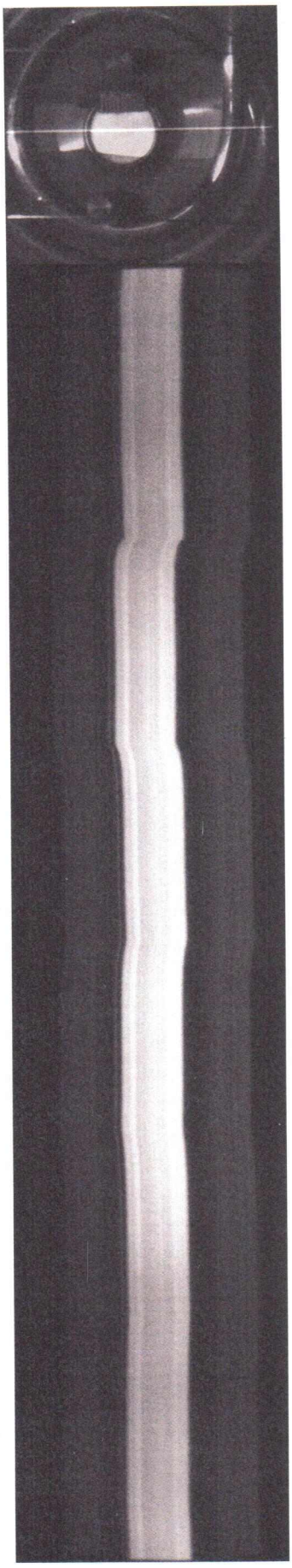
58	5.700	11.300	-0.13155	282	28.100	-11.100	-0.13110
59	5.800	11.200	-0.13155	283	28.200	-11.200	-0.13115
60	5.900	11.100	-0.13155	284	28.300	-11.300	-0.13110
61	6.000	11.000	-0.13155	285	28.400	-11.400	-0.13110
62	6.100	10.900	-0.13155	286	28.500	-11.500	-0.13110
63	6.200	10.800	-0.13155	287	28.600	-11.600	-0.13110
64	6.300	10.700	-0.13155	288	28.700	-11.700	-0.13110
65	6.400	10.600	-0.13155	289	28.800	-11.800	-0.13110
66	6.500	10.500	-0.13155	290	28.900	-11.900	-0.13110
67	6.600	10.400	-0.13155	291	29.000	-12.000	-0.13110
68	6.700	10.300	-0.13155	292	29.100	-12.100	-0.13105
69	6.800	10.200	-0.13160	293	29.200	-12.200	-0.13110
70	6.900	10.100	-0.13155	294	29.300	-12.300	-0.13105
71	7.000	10.000	-0.13155	295	29.400	-12.400	-0.13105
72	7.100	9.900	-0.13155	296	29.500	-12.500	-0.13105
73	7.200	9.800	-0.13155	297	29.600	-12.600	-0.13105
74	7.300	9.700	-0.13155	298	29.700	-12.700	-0.13105
75	7.400	9.600	-0.13155	299	29.800	-12.800	-0.13110
76	7.500	9.500	-0.13150	300	29.900	-12.900	-0.13100
77	7.600	9.400	-0.13150	301	30.000	-13.000	-0.13100
78	7.700	9.300	-0.13150	302	30.100	-13.100	-0.13105
79	7.800	9.200	-0.13150	303	30.200	-13.200	-0.13100
80	7.900	9.100	-0.13150	304	30.300	-13.300	-0.13105
81	8.000	9.000	-0.13150	305	30.400	-13.400	-0.13100
82	8.100	8.900	-0.13150	306	30.500	-13.500	-0.13100
83	8.200	8.800	-0.13150	307	30.600	-13.600	-0.13100
84	8.300	8.700	-0.13150	308	30.700	-13.700	-0.13095
85	8.400	8.600	-0.13150	309	30.800	-13.800	-0.13095
86	8.500	8.500	-0.13150	310	30.900	-13.900	-0.13095
87	8.600	8.400	-0.13150	311	31.000	-14.000	-0.13095
88	8.700	8.300	-0.13150	312	31.100	-14.100	-0.13095
89	8.800	8.200	-0.13150	313	31.200	-14.200	-0.13095
90	8.900	8.100	-0.13150	314	31.300	-14.300	-0.13095
91	9.000	8.000	-0.13150	315	31.400	-14.400	-0.13095
92	9.100	7.900	-0.13150	316	31.500	-14.500	-0.13095
93	9.200	7.800	-0.13150	317	31.600	-14.600	-0.13090
94	9.300	7.700	-0.13150	318	31.700	-14.700	-0.13090
95	9.400	7.600	-0.13150	319	31.800	-14.800	-0.13090
96	9.500	7.500	-0.13150	320	31.900	-14.900	-0.13085
97	9.600	7.400	-0.13150	321	32.000	-15.000	-0.13085
98	9.700	7.300	-0.13150	322	32.100	-15.100	-0.13085
99	9.800	7.200	-0.13150	323	32.200	-15.200	-0.13085
100	9.900	7.100	-0.13145	324	32.300	-15.300	-0.13085
101	10.000	7.000	-0.13145	325	32.400	-15.400	-0.13080
102	10.100	6.900	-0.13150	326	32.500	-15.500	-0.13085
103	10.200	6.800	-0.13150	327	32.600	-15.600	-0.13085
104	10.300	6.700	-0.13150	328	32.700	-15.700	-0.13080
105	10.400	6.600	-0.13145	329	32.800	-15.800	-0.13085
106	10.500	6.500	-0.13145	330	32.900	-15.900	-0.13085
107	10.600	6.400	-0.13145	331	33.000	-16.000	-0.13080
108	10.700	6.300	-0.13140	332	33.100	-16.100	-0.13085
109	10.800	6.200	-0.13140	333	33.200	-16.200	-0.13080
110	10.900	6.100	-0.13145	334	33.300	-16.300	-0.13080
111	11.000	6.000	-0.13140	335	33.400	-16.400	-0.13080
112	11.100	5.900	-0.13140	336	33.500	-16.500	-0.13085
113	11.200	5.800	-0.13140	337	33.600	-16.600	-0.13085
114	11.300	5.700	-0.13140	338	33.700	-16.700	-0.13085
115	11.400	5.600	-0.13110	339	33.800	-16.800	-0.13085
116	11.500	5.500	-0.12860	340	33.900	-16.900	-0.13085
117	11.600	5.400	-0.12935	341	34.000	-17.000	-0.13095

ow the center with 0.100 MM increment

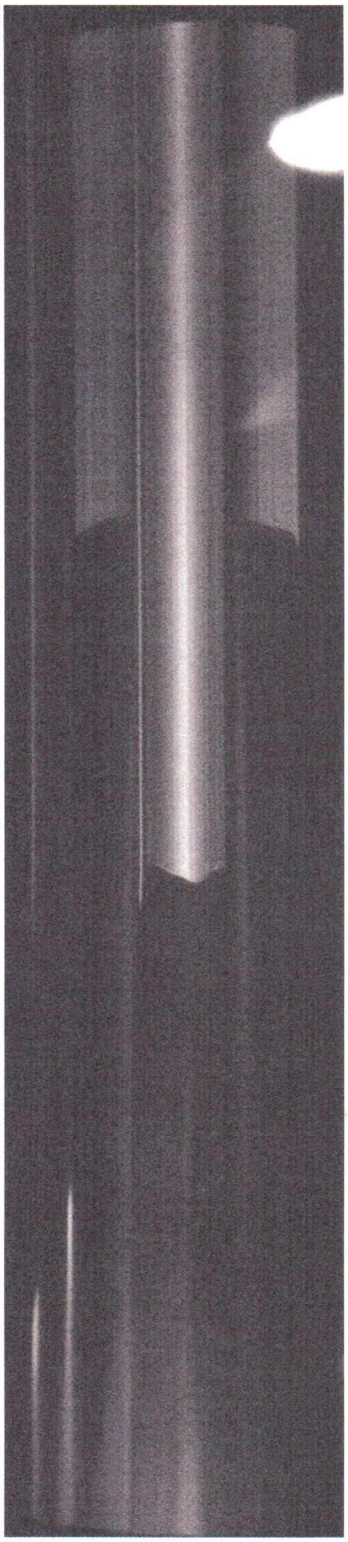
# reading	dist(mm)	absdist(mm	1st	2nd	3 rd
118	11.700	5.300	Run	Run	Run
119	11.800	5.200	Reading	Reading	Reading
120	11.900	5.100	Inches	Inches	Inches
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	-0.00085		
125	12.400	4.600	-0.00065		
126	12.500	4.500	-0.00050	-0.00050	
127	12.600	4.400	-0.00040	-0.00040	
128	12.700	4.300	-0.00030	-0.00035	
129	12.800	4.200	-0.00025	-0.00030	
130	12.900	4.100	-0.00025	-0.00030	0.00000
131	13.000	4.000	-0.00025	-0.00030	0.00000
132	13.100	3.900	-0.00020	-0.00030	0.00000
133	13.200	3.800	-0.00020	-0.00030	0.00000
134	13.300	3.700	-0.00025	-0.00025	0.00000
135	13.400	3.600	-0.00020	-0.00025	0.00000
136	13.500	3.500	-0.00020	-0.00025	0.00000
137	13.600	3.400	-0.00020	-0.00025	0.00000
138	13.700	3.300	-0.00020	-0.00020	0.00000
139	13.800	3.200	-0.00020	-0.00025	0.00000
140	13.900	3.100	-0.00020	-0.00020	0.00000
141	14.000	3.000	-0.00015	-0.00020	0.00000
142	14.100	2.900	-0.00015	-0.00020	0.00000
143	14.200	2.800	-0.00015	-0.00015	0.00000
144	14.300	2.700	-0.00015	-0.00020	0.00000
145	14.400	2.600	-0.00015	-0.00015	0.00000
146	14.500	2.500	-0.00010	-0.00015	0.00000
147	14.600	2.400	-0.00010	-0.00015	0.00000
148	14.700	2.300	-0.00010	-0.00010	0.00000
149	14.800	2.200	-0.00010	-0.00010	0.00000
150	14.900	2.100	-0.00010	-0.00015	0.00000
151	15.000	2.000	-0.00010	-0.00015	0.00000
152	15.100	1.900	-0.00005	-0.00010	0.00000
153	15.200	1.800	-0.00010	-0.00010	0.00000
154	15.300	1.700	-0.00010	-0.00010	0.00000
155	15.400	1.600	-0.00010	-0.00010	0.00000
156	15.500	1.500	-0.00005	-0.00010	0.00000
157	15.600	1.400	-0.00005	-0.00005	0.00000
158	15.700	1.300	0.00000	-0.00005	0.00000
159	15.800	1.200	0.00000	-0.00005	0.00000
160	15.900	1.100	0.00000	-0.00010	0.00000
161	16.000	1.000	0.00000	0.00000	0.00000
162	16.100	0.900	0.00000	0.00000	0.00000
163	16.200	0.800	-0.00005	0.00000	0.00000
164	16.300	0.700	0.00000	-0.00005	0.00000
165	16.400	0.600	0.00000	0.00000	0.00000
166	16.500	0.500	0.00000	0.00000	0.00000
167	16.600	0.400	0.00000	-0.00005	0.00000
168	16.700	0.300	0.00000	-0.00005	0.00000
169	16.800	0.200	0.00000	0.00000	0.00000
170	16.900	0.100	0.00005	0.00000	0.00000
171	17.000	0.000	0.00005	0.00000	0.00000
172	17.100	-0.100	0.00005	0.00000	0.00000
173	17.200	-0.200	0.00005	0.00000	0.00000
174	17.300	-0.300	0.00005	0.00000	0.00000

175	17.400	-0.400	0.00005	0.00000	0.00000
176	17.500	-0.500	0.00005	0.00000	0.00000
177	17.600	-0.600	0.00005	0.00000	0.00000
178	17.700	-0.700	0.00005	0.00000	0.00000
179	17.800	-0.800	0.00010	0.00000	0.00000
180	17.900	-0.900	0.00005	0.00000	0.00000
181	18.000	-1.000	0.00005	0.00000	0.00000
182	18.100	-1.100	0.00005	0.00005	0.00000
183	18.200	-1.200	0.00010	0.00005	0.00000
184	18.300	-1.300	0.00010	0.00005	0.00000
185	18.400	-1.400	0.00010	0.00005	0.00000
186	18.500	-1.500	0.00010	0.00005	0.00000
187	18.600	-1.600	0.00010	0.00010	0.00000
188	18.700	-1.700	0.00010	0.00010	0.00000
189	18.800	-1.800	0.00010	0.00005	0.00000
190	18.900	-1.900	0.00010	0.00005	0.00000
191	19.000	-2.000	0.00010	0.00005	0.00000
192	19.100	-2.100	0.00010	0.00010	0.00000
193	19.200	-2.200	0.00015	0.00010	0.00000
194	19.300	-2.300	0.00015	0.00010	0.00000
195	19.400	-2.400	0.00010	0.00010	0.00000
196	19.500	-2.500	0.00010	0.00010	0.00000
197	19.600	-2.600	0.00010	0.00010	0.00000
198	19.700	-2.700	0.00015	0.00010	0.00000
199	19.800	-2.800	0.00010	0.00010	0.00000
200	19.900	-2.900	0.00010	0.00010	0.00000
201	20.000	-3.000	0.00015	0.00010	0.00000
202	20.100	-3.100	0.00015	0.00010	0.00000
203	20.200	-3.200	0.00010	0.00010	0.00000
204	20.300	-3.300	0.00015	0.00010	0.00000
205	20.400	-3.400	0.00015	0.00010	0.00000
206	20.500	-3.500	0.00015	0.00010	0.00000
207	20.600	-3.600	0.00015	0.00010	0.00000
208	20.700	-3.700	0.00015	0.00010	0.00000
209	20.800	-3.800	0.00015	0.00010	0.00000
210	20.900	-3.900	0.00015	0.00015	0.00000
211	21.000	-4.000	0.00015	0.00020	0.00000
212	21.100	-4.100	0.00010	0.00010	0.00000
213	21.200	-4.200	-0.00020	-0.00020	0.00000
214	21.300	-4.300	-0.00055	-0.00050	0.00000
215	21.400	-4.400	-0.00080	-0.00075	
216	21.500	-4.500	-0.00070	-0.00070	
217	21.600	-4.600	-0.00035	-0.00035	
218	21.700	-4.700	-0.00020		
219	21.800	-4.800	-0.00010		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

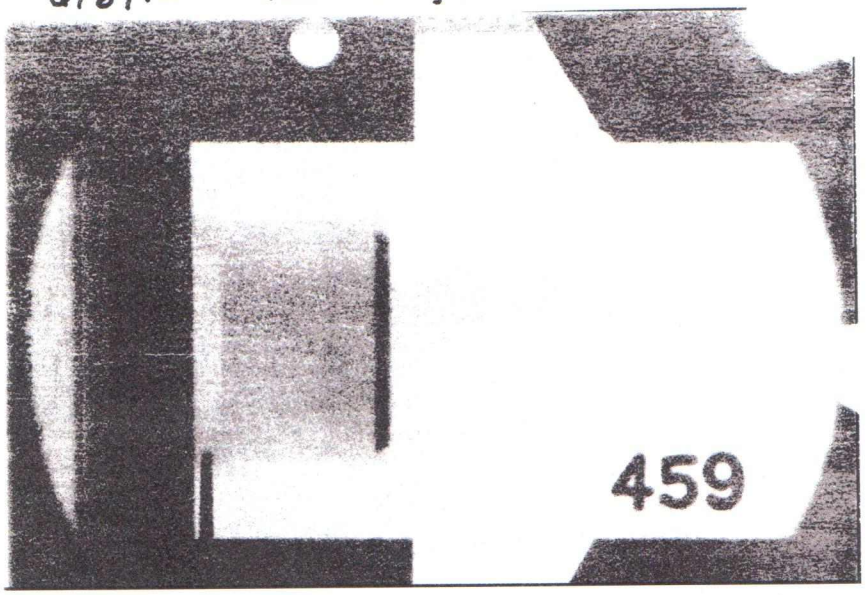
#459



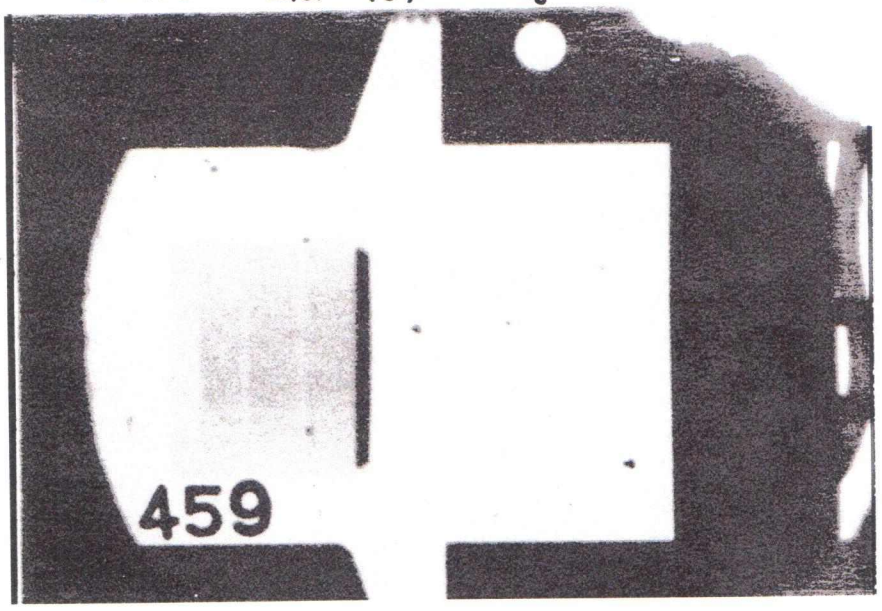
SHOT #459



6/8/12 #459 Xray # 1

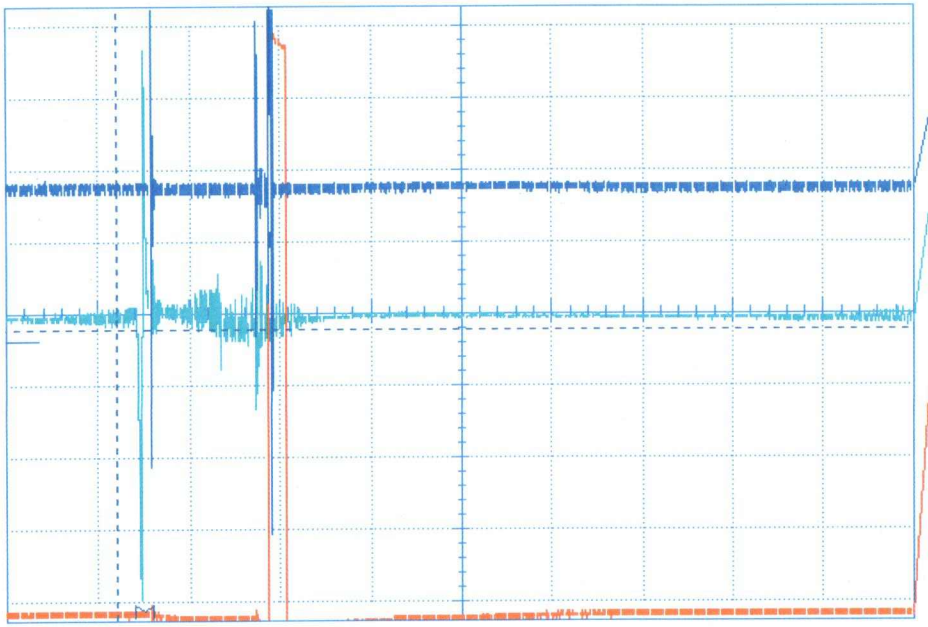


6/8/12 LGG #459 Xray #2



G57 #459

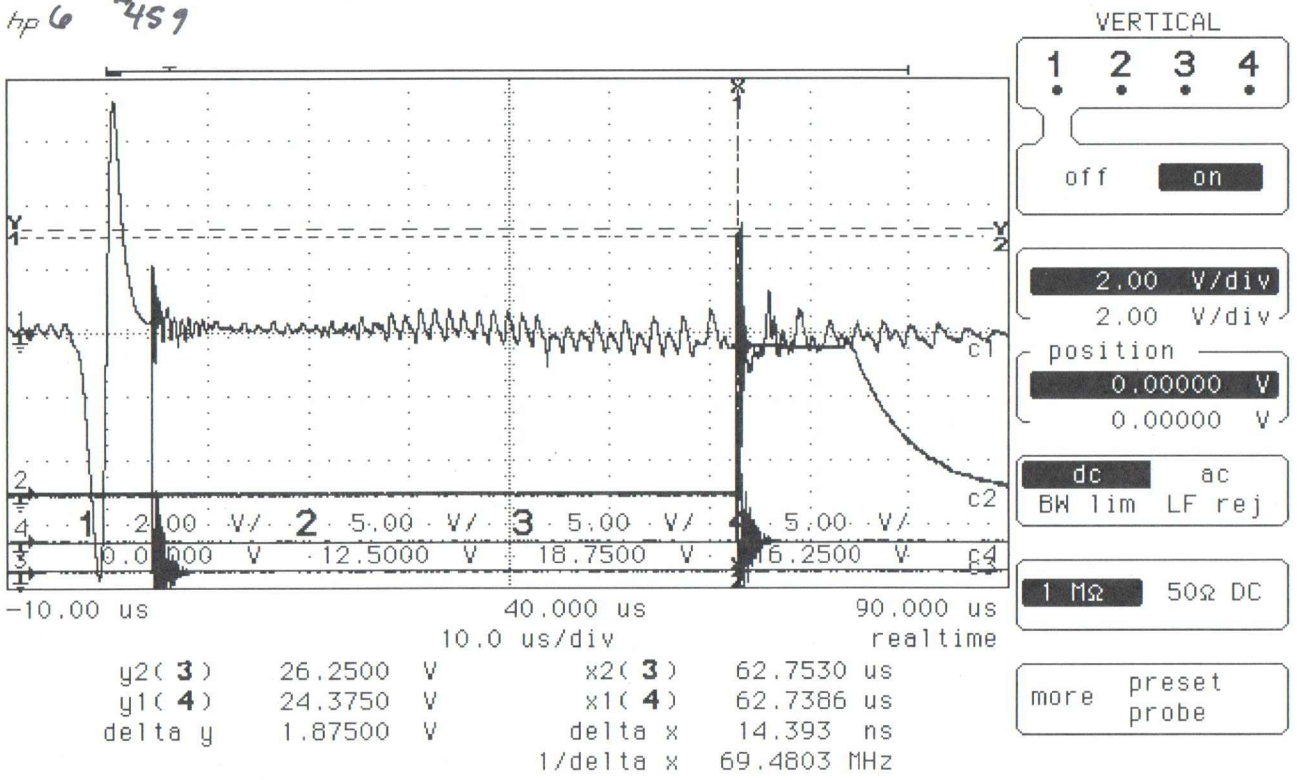
PRINTED : Jun-8-2012:11.11.43
PRODUCT : Classic 6500 S/N 84900024



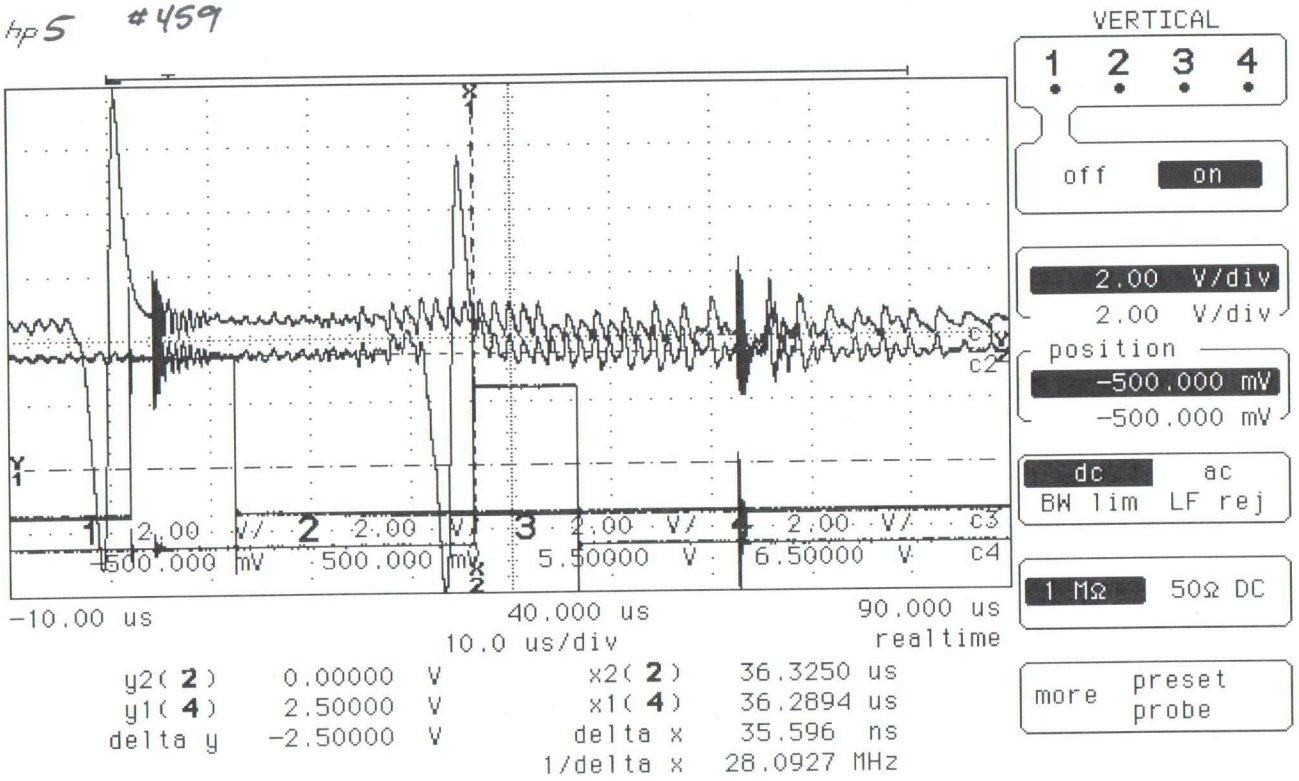
TRC4M:
(Jun-8-2012:10.43.49)
100mV/div,50µs/div
TRC1M:
(Jun-8-2012:10.43.49)
2V/div,50µs/div
TRC3M:
(Jun-8-2012:10.43.49)
5V/div,50µs/div

TR4M
CURSOR :TRC2 -14.6V
+144.7395µs
CURSOR :TRC1 -340mV
+84.73950µs
CURSOR :TRC3 +41.5V
+84.73950µs
CURSOR :TRC4 +186mV
+84.73950µs

hp 6 #459


VERTICAL
1 2 3 4
off on
2.00 V/div
2.00 V/div
position
0.00000 V
0.00000 V
dc ac
BW lim LF rej
1 MΩ 50Ω DC
more preset probe
c1
c2
c4
1 2.00 V/ 2 5.00 V/ 3 5.00 V/ 4 5.00 V/
0.0000 V 12.5000 V 18.7500 V 26.2500 V
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(3) 26.2500 V
y1(4) 24.3750 V
delta y 1.87500 V
x2(3) 62.7530 us
x1(4) 62.7386 us
delta x 14.393 ns
1/delta x 69.4803 MHz

hp 5 #459


VERTICAL
1 2 3 4
off on
2.00 V/div
2.00 V/div
position
-500.000 mV
-500.000 mV
dc ac
BW lim LF rej
1 MΩ 50Ω DC
more preset probe
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/ c3
-500.000 mV 500.000 mV 5.50000 V 6.50000 V c4
-10.00 us 40.000 us 90.000 us
10.0 us/div realtime
y2(2) 0.00000 V x2(2) 36.3250 us
y1(4) 2.50000 V x1(4) 36.2894 us
delta y -2.50000 V delta x 35.596 ns
1/delta x 28.0927 MHz

LIGHT GAS GUN DATA SHEET

Shot No. 466 Date 8/8/12

Target:

Sample Material Fin-Hd (#31) Crystallographic orientation _____

Source Location UMich - R.Lange Thickness:1 _____ in.

Type of Measurement Pre-heated EOS 1400°C 2. _____ in.

Bulk Density _____ gm/cc Crystal Density _____ gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. _____ gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in. Material Mo

Projectile: Mo #8 (Pressed 5/16/12)

Weight 20.1488 gms. Length 0.9055 in. Skirt Diameter 1.1126 in.

Flyer Plate Material Mo (#8 old GM-LT) Leading Edge Dia. 1.1004 in.

Thickness 0.06110 in. Major Dia. 0.7845 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. Pressure 150 psi Temp 21 °C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.111 in.

Diameter: Front 3.494 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure _____ in. Hg Fill Pressure _____ psig.

Powder Charge:

Main Charge 388 gms. Type IMR 4350 Total Charge 400 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 3.5 km/sec Piston .4473 km/sec

Notes:

AMPS	KV	TEMP
0.2	4k	1402°C

Pump Tube filled to 161 psi (Not 170)

From code Predicted 3.66 km/s

L.G.G.

Camera Streak Duration: 1500 nsec Timing calibration frequency: 147.8950 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification 35 px/mm

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 5.2 µsec Flash X-ray #2 106 µsec

Static Streak Photo ——— µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0559 in. min. 0.0934 in. min.

0.0562 in. max. 0.0936 in. max

Expected Burst Pressure 4k psi

Instrument Tank/Vacuum Pump Pressure: 100/102 µm

Distances:		
	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	21.68 cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: 0.461 km/sec

Piston Velocity from Gauge #1 to #3: 0.455 km/sec

Projectile Velocity from UDC: 3615 m/sec

Projectile Velocity from X-ray: 3.621 km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	661 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1339 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	56.4 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	~~-~~ 99.840 µsec ~~-~~ WRONG POLARITY
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	107.878 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.670 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	100.263 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	56.32 µsec
UDC Velocity:			3615.16 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	27 257.8 ns
HP5, 2:	Velocity magnet 2	56.5726 µsec
HP5, 3:	TTL Start	2.23980 µsec
HP5, 4:	TTL Stop	58.55640 µsec
HP6, 1:	Velocity Magnet 1	239.40 ns
HP6,2:	Xenon Lamp Trigger	109.2046 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	8.08360 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	108.3442 µsec
GS7, 1:	Velocity Magnet 1	-5.7473 µsec
GS7,3:	Camera Trigger (UDC HV 1)	109.5885 µsec
GS7, 4:	Camera Monitor Out	109.8050 µsec

Shot 466 Nominal Timeline Preshot

V	3500			meters	mag SIM time	58173 ns	
cable time	90	150	M1-M2 distance	0.203606			
intervalometer intrinsic delay	[redacted]		M2-target distance	0.216789			
UDC extra count lag	[redacted]		M2-target fudge	[redacted]			
pulse translator delay	150		M1-fid1 distance	0.03			
X-ray 1 program delay	[redacted]	5279 X-ray 1 actual delay	M1-fid2 distance	0.383145			
X-ray 2 program delay	[redacted]	106177 X-ray 2 actual delay	Flyer thickness	0.00155194			
X-ray 1 pulser delay	600						
X-ray 2 pulser delay	[redacted]		Us(Mo)	7210.00583			
Camera intrinsic delay	107		driver thickness	0.00103886			
Lamp trigger to peak brightness	7127		cap thickness	0.00076276			
HV#3 delay to lamp	-6370		estimated sample+cover time	253.216292			
Streak duration	1514						
Desired dead streak before driver	500						

	rho0	Co	s		
Cold Mo	10206	5033	1.28946405		
Hot Mo	9937	4918.5831	1.28837124	1407	
Liquid An-Hd	2788.69	2769.8	1.5714		

			up	P	Us
driver	357.7250824	-192364649	3.40997E+11	1778.54228	127.425134	7210.00583
sample	8420.397546	-147679517	3.35845E+11	2685.28941	52.3401032	6989.45377
cap	-8420.39755	-103669383	1.67878E+11	1448.85314	97.6888762	6785.24381

t (ns)	flyer x (m)	shock front (m)	event
0	0.00077597		M1 zero-crossing
150	0.00130097		HP5-1, GS7-1, HP6-1, Intervalometer start
2230	0.00858097		HP5-3, UDC start, signal to pulse translator
2380	0.00910597		pulse translator out
7659	0.02758247		X-ray 1 delay amp out to counters 4, 5
8349	0.02999747		X-ray 1 fires
8439	0.03031247		X-ray 1 pulse monitor at counter 4b
58173	0.20438197		M2 zero-crossing
58323	0.20490697		HP5-2, Intervalometer stop
60403	0.21218697		HP5-4, UDC stop
108557	0.38072547		X-ray 2 delay amp, stop counter 4, start counter 6
109272	0.38322797		X-ray 2 fires
109362	0.38354297		X-ray 2 pulse monitor at counter 4b
119338	0.4184598		UDC out, GS7-3, stop counters 5 and 6
119428	0.4187748		Trigger at camera
119535	0.4191493		Begin Streak
119625	0.4194643		Camera Monitor on GS7-4
119891	0.420395	0	IMPACT
120035		0.00103886	Driver arrival on streak
120288		0.002864551	Sample cutoff on streak
121049		0.008349806	End Streak

				X-ray velocity		3500
					On film	
X-ray 1 flyer vs. fid (mm)				-0.00253	-0.0029419	
Counter 3:	58173					
			HP5 2-1		58173	
UDC upcount:	58173		HP5 4-3		58173	
Counter 4:	100898					
X-ray 2 flyer vs. fid (mm)				0.08297	0.09647674	
Counter 4b:	100923					
Counter 5:	111679		GS7 3-1		119188	
Counter 6:	10781		GS7 4-1		119475	
			HP6-1			

		scopes		
trig	GS7-1	0	10V pp	rising
sim only	GS7-2	119838	10 V _-_	ttl
	GS7-3	119188	40 V _-_	
	GS7-4	119475	(-)1.75 V	down going
trig	HP5-1	0	10V pp	rising
	HP5-2	58173	10V pp	rising
	HP5-3	2080	5 V _-_	
	HP5-4	60253	5 V _-_	
trig	HP6-1	0	10V pp	rising
HV#1-14.3us	HP6-2	112968	10 V _-_	
	HP6-3	8289	25 V /\	
	HP6-4	109212	25 V /\	

Driver cutoff on streak	500
Sample cutoff on sreak	753

Shot 466 Nominal Timeline Preshot

V	3200				meters	mag SIM time	63627	ns			rho0	Co	s						
cable time	90	150		M1-M2 distance	0.203606					Cold Mo	10206	5033	1.28946405						
intervalometer intrinsic delay	[redacted]			M2-target distance	0.216789					Hot Mo	9937	4918.5831	1.28837124	1407					
UDC extra count lag	[redacted]			M2-target fudge	[redacted]					Liquid An-Hd	2788.69	2769.8	1.5714						
pulse translator delay	150			M1-fid1 distance	0.03														
X-ray 1 program delay	[redacted]	6062	X-ray 1 actual delay	M1-fid2 distance	0.383145														
X-ray 2 program delay	[redacted]	116419	X-ray 2 actual delay	Flyer thickness	0.00155194														
X-ray 1 pulser delay	600															up	P	Us	
X-ray 2 pulser delay	[redacted]			Us(Mo)	7014.42317					driver	357.7250824	-184468487	2.99135E+11	1626.73615	113.387289	7014.42317			
Camera intrinsic delay	107			driver thickness	0.00103886					sample	8420.397546	-139905497	2.94533E+11	2473.43914	45.9146009	6656.55226			
Lamp trigger to peak brightness	7127			cap thickness	0.00076276					cap	-8420.39755	-99955946	1.45448E+11	1310.45696	86.0356199	6606.93815			
HV#3 delay to lamp	-6370			estimated sample+cover time	262.69156														
Streak duration	1514																		
Desired dead streak before driver	500																		

t (ns)	flyer x (m)	shock front (m)	event									
0	0.00077597		M1 zero-crossing									
150	0.00125597		HP5-1, GS7-1, HP6-1, Intervalometer start				X-ray velocity	3200				
2230	0.00791197		HP5-3, UDC start, signal to pulse translator					On film				
2380	0.00839197		pulse translator out	X-ray 1 flyer vs. fid (mm)		-0.00163	-0.0018953					
8442	0.02779037		X-ray 1 delay amp out to counters 4, 5								scopes	
9132	0.02999837		X-ray 1 fires							triq	GS7-1	0 10V pp rising
9222	0.03028637		X-ray 1 pulse monitor at counter 4b							sim only	GS7-2	131082 10 V _-_ ttl
63627	0.20438197		M2 zero-crossing	Counter 3:	63627						GS7-3	130432 40 V _-_
63777	0.20486197		HP5-2, Intervalometer stop			HP5 2-1	63627				GS7-4	130719 (-)1.75 V down going
65857	0.21151797		HP5-4, UDC stop	UDC upcount:	63627	HP5 4-3	63627			triq	HP5-1	0 10V pp rising
118799	0.38093277		X-ray 2 delay amp, stop counter 4, start counter 6	Counter 4:	110357						HP5-2	63627 10V pp rising
119514	0.38322077		X-ray 2 fires	X-ray 2 flyer vs. fid (mm)		0.07577	0.08810465				HP5-3	2080 5 V _-_
119604	0.38350877		X-ray 2 pulse monitor at counter 4b	Counter 4b:	110382						HP5-4	65707 5 V _-_
130582	0.41863853		UDC out, GS7-3, stop counters 5 and 6	Counter 5:	122140	GS7 3-1	130432			triq	HP6-1	0 10V pp rising
130672	0.41892653		Trigger at camera	Counter 6:	11783	GS7 4-1	130719			HV#1-14.3us	HP6-2	124212 10 V _-_
130779	0.41926893		Begin Streak								HP6-3	9072 25 V /\
130869	0.41955693		Camera Monitor on GS7-4			HP6-1					HP6-4	119454 25 V /\
131131	0.420395	0	IMPACT									
131279		0.00103886	Driver arrival on streak									
131542		0.00288149	Sample cutoff on streak									
132293		0.008151485	End Streak									

Driver cutoff on streak	500
Sample cutoff on sreak	763

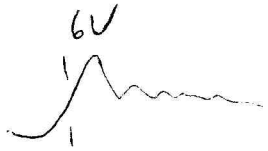
SHOT SIMULATION #2

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	57.600 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	101.363 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	110.276 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	8.530 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	101.758 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	57.52 µsec
UDC Velocity:			3539.72 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	439.80 ns
HP5, 2:	Velocity magnet 2	57.9958 µsec
HP5, 3:	TTL Start	2.4382 µsec
HP5, 4:	TTL Stop	59.9524 µsec
HP6, 1:	Velocity Magnet 1	419 ns
HP6,2:	Xenon Lamp Trigger	111.785 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	8.2816 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	110.0352 µsec
GS7, 1:	Velocity Magnet 1	-5.557 µsec
GS7, 2:	Camera Cal. Sig.	112.850 µsec
GS7,3:	Camera Trigger (UDC HV 1)	112.1670 µsec
GS7, 4:	Camera Monitor Out	112.3845 µsec



#166 #1

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	57.77
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	101.250 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	110.708 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	~~9.087~~ µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	~~10~~ 9.087 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	101.662 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	57.72 µsec
UDC Velocity:			3527.48 M/sec

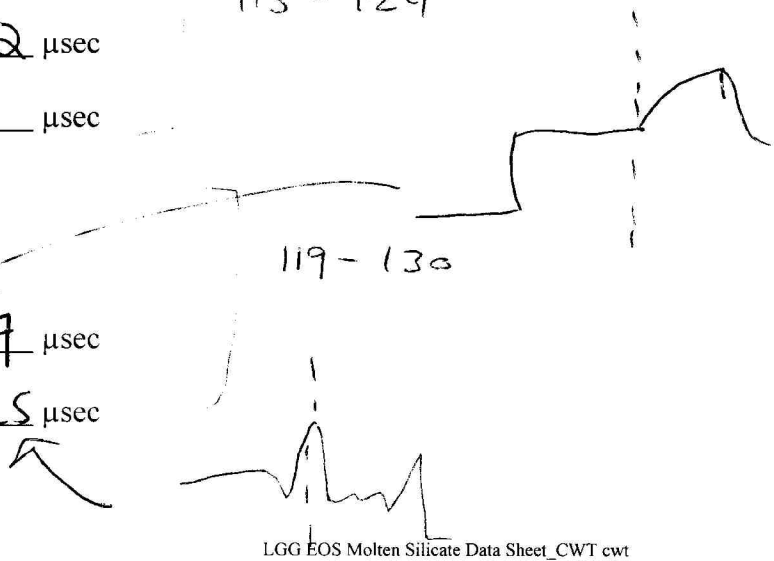
OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	2.22940 ns
HP5, 2:	Velocity magnet 2	59.90 µsec
HP5, 3:	TTL Start	4.2266 µsec
HP5, 4:	TTL Stop	61.958 µsec
HP6, 1:	Velocity Magnet 1	2.2156 ~~ns~~ µs
HP6,2:	Xenon Lamp Trigger	~~4.2266~~ µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	10.0542 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	_____ µsec
GS7, 1:	Velocity Magnet 1	3.515 µsec
GS7, 2:	Camera Cal. Sig.	115.3275 µsec
GS7,3:	Camera Trigger (UDC HV 1)	114.647 µsec
GS7, 4:	Camera Monitor Out	114.8625 µsec

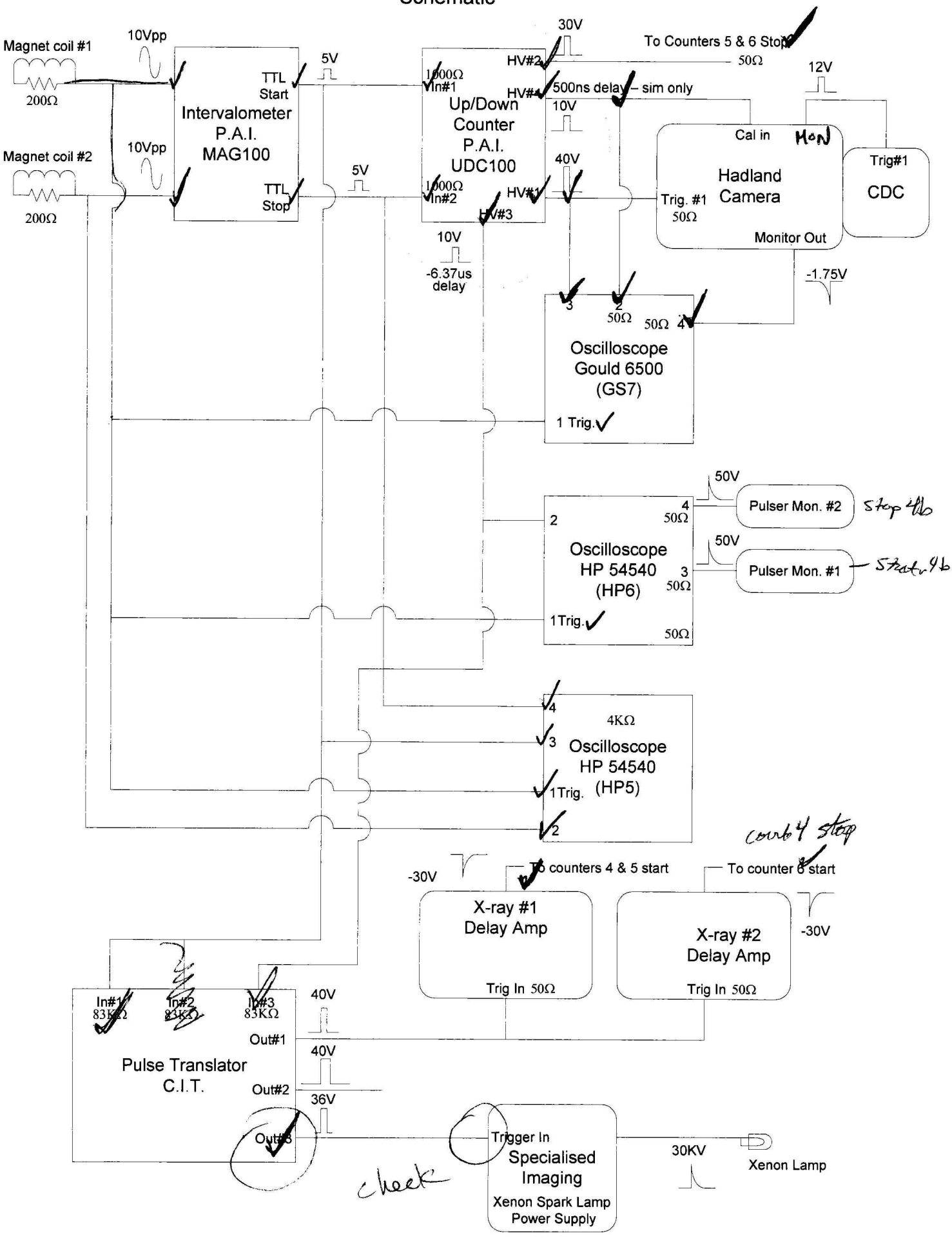
3.2.
~~119~~ 60 - 66

113 - 124

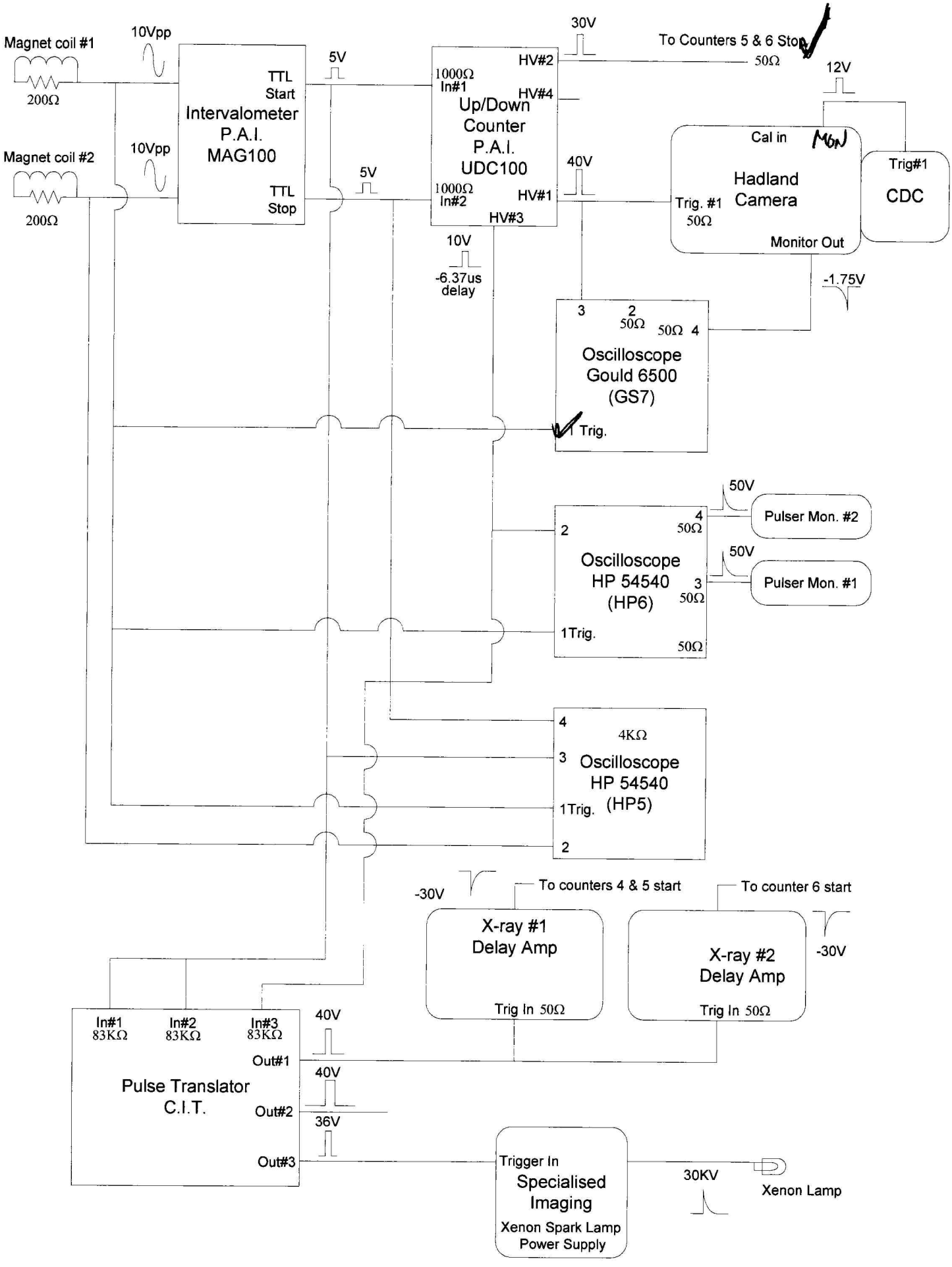
119 - 130



Shot ~~#457~~ 466 SIM Scope Schematic



Shot #~~457~~ 466 Scope Schematic



MAGNET DISTANCE

Shot No. **466** Expected Velocity: **3.50**

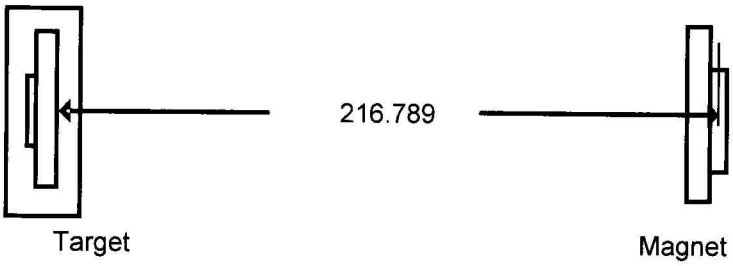
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **58.173 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.410 inch

Second measurement = 8.410 inch

Average measurement = 8.410 inch

Average measurement = 213.614 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

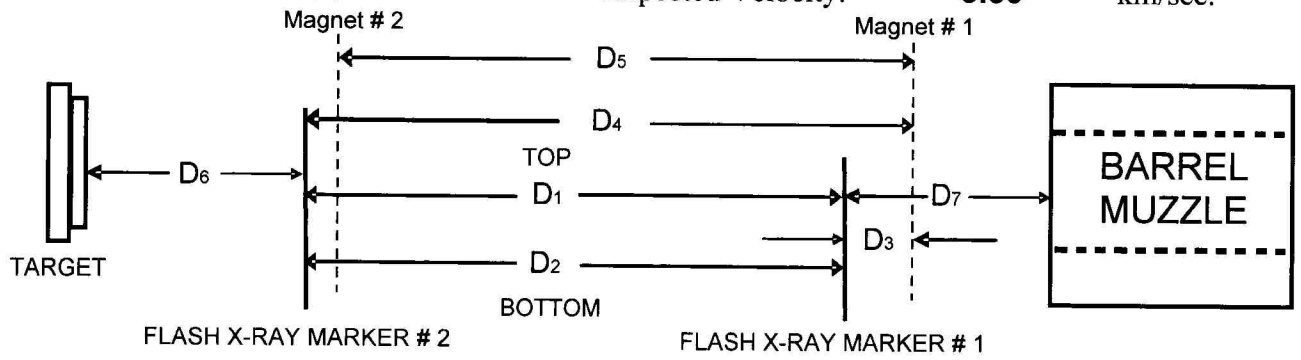
Distance Between Magnet # 2 to Target = 216.789 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **61.940 µsec.**

Fudged Distance between Magnet 2 to Target = 205.845 mm

TARGET MEASUREMENT

Shot No. **466** Expected Velocity: **3.50** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	8.375	99.0
Measure # 2, mm	30.00	383.15	203.66	8.377	99.0
Average, mm	30.00	383.15	203.61	8.376	99.0
Travel time, µsec	**8.57**	**109.47**	**58.17**	**2.39**	**28.29**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **100.92** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

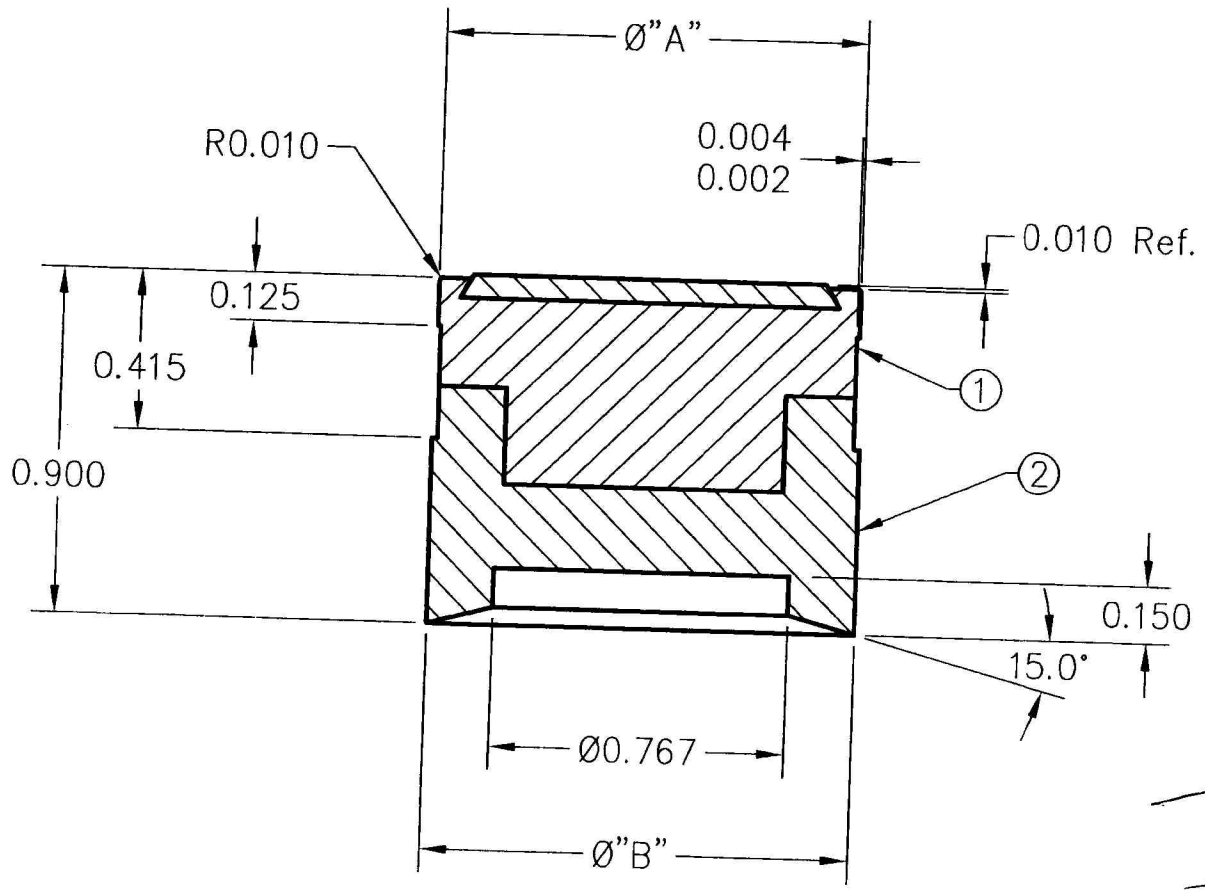
Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **100.88** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **5.47** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **106.82** µsec.

sheet values
5279
106177



Mo # 8

BUILT AS

1.1004

1.1126

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-128	1
1	Sabot & Flyer Plate	LGG-157	1

	SHOT#	
A	1.1007	+.0000 −.0005
B	1.1125	+.0005 −.0000

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN: M. Long — DATE: 11/29/10
ENGINEER — DATE
APPROVED — DATE

MATERIAL: Zelux-M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy. for 28mm launch tube (GM)

SCALE: 2:1 | SHEET: 2 of 2 | A | DRAWING NUMBER: LGG-158

SHOT No. _____ tip used: .7mm long/ flat tip

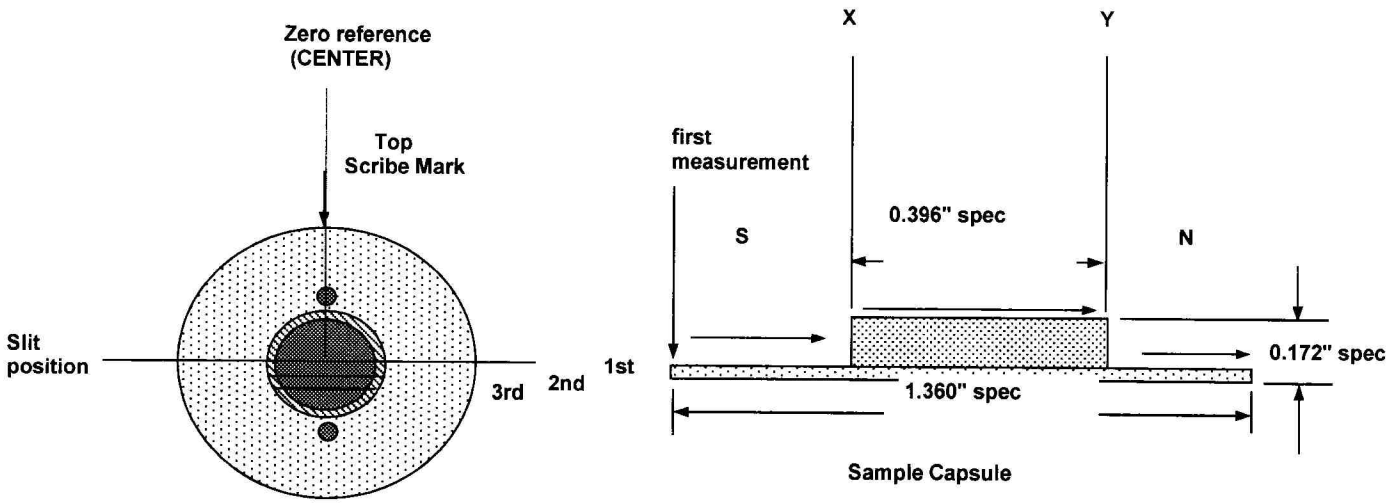
SAMPLE CAPSULE: 31

SAMPLE MATERIAL: An-Hd

direction of measurement

5.33

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

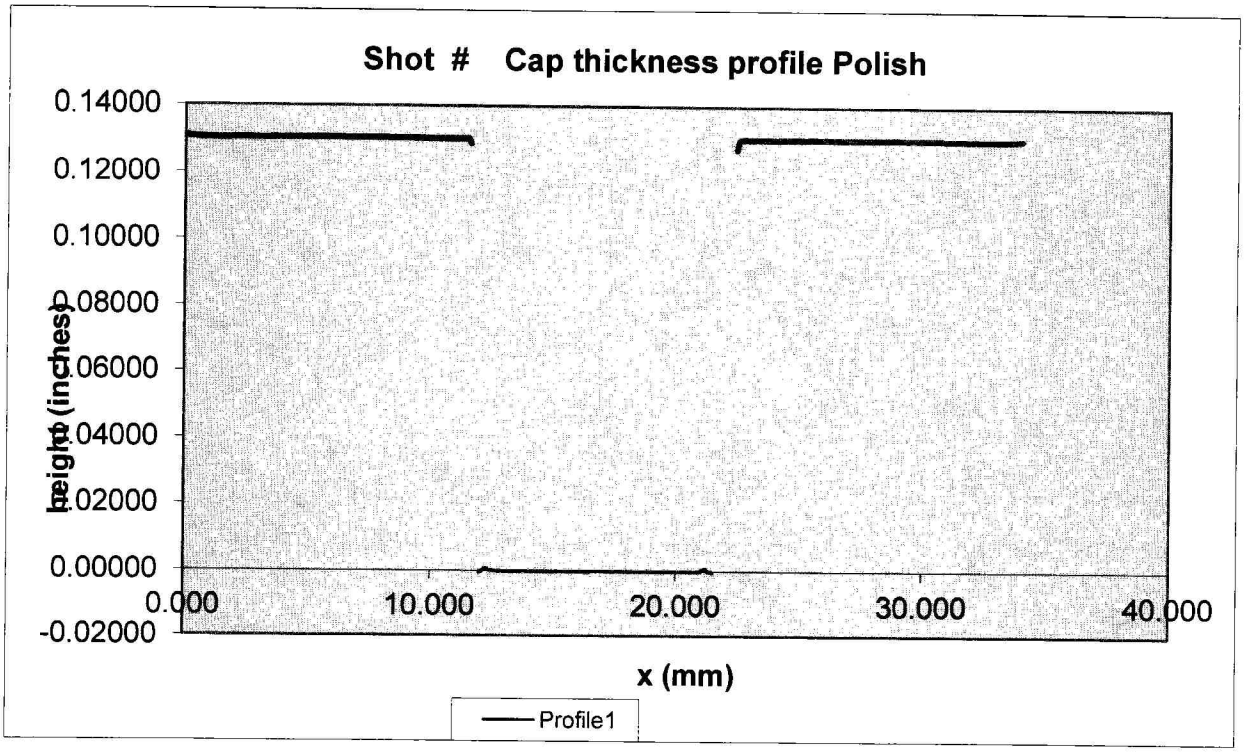
Average thickness reading = -0.00016

Note: Measurement from reference zero point from the base is = **-0.1713** Inches
-4.3510 mm

Average thickness of the driver Plate = -0.0409 Inches
-1.0398 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
Height (inches)
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s	# reading	dist(mm)
1	0.000	17.000	0.1310	225	22.400	-5.400	0.1272	118	11.700
2	0.100	16.900	0.1309	226	22.500	-5.500	0.1300	119	11.800
3	0.200	16.800	0.1308	227	22.600	-5.600	0.1301	120	11.900
4	0.300	16.700	0.1308	228	22.700	-5.700	0.1302	121	12.000
5	0.400	16.600	0.1307	229	22.800	-5.800	0.1302	122	12.100
6	0.500	16.500	0.1307	230	22.900	-5.900	0.1302	123	12.200
7	0.600	16.400	0.1306	231	23.000	-6.000	0.1302	124	12.300
8	0.700	16.300	0.1306	232	23.100	-6.100	0.1302	125	12.400
9	0.800	16.200	0.1306	233	23.200	-6.200	0.1302	126	12.500
10	0.900	16.100	0.1306	234	23.300	-6.300	0.1302	127	12.600
11	1.000	16.000	0.1305	235	23.400	-6.400	0.1302	128	12.700
12	1.100	15.900	0.1305	236	23.500	-6.500	0.1302	129	12.800
13	1.200	15.800	0.1305	237	23.600	-6.600	0.1302	130	12.900
14	1.300	15.700	0.1305	238	23.700	-6.700	0.1302	131	13.000
15	1.400	15.600	0.1305	239	23.800	-6.800	0.1302	132	13.100
16	1.500	15.500	0.1305	240	23.900	-6.900	0.1302	133	13.200
17	1.600	15.400	0.1305	241	24.000	-7.000	0.1302	134	13.300
18	1.700	15.300	0.1305	242	24.100	-7.100	0.1302	135	13.400
19	1.800	15.200	0.1305	243	24.200	-7.200	0.1302	136	13.500
20	1.900	15.100	0.1305	244	24.300	-7.300	0.1302	137	13.600
21	2.000	15.000	0.1305	245	24.400	-7.400	0.1302	138	13.700
22	2.100	14.900	0.1305	246	24.500	-7.500	0.1302	139	13.800
23	2.200	14.800	0.1306	247	24.600	-7.600	0.1302	140	13.900
24	2.300	14.700	0.1306	248	24.700	-7.700	0.1302	141	14.000
25	2.400	14.600	0.1305	249	24.800	-7.800	0.1303	142	14.100
26	2.500	14.500	0.1306	250	24.900	-7.900	0.1303	143	14.200
27	2.600	14.400	0.1305	251	25.000	-8.000	0.1303	144	14.300
28	2.700	14.300	0.1306	252	25.100	-8.100	0.1303	145	14.400
29	2.800	14.200	0.1306	253	25.200	-8.200	0.1303	146	14.500
30	2.900	14.100	0.1306	254	25.300	-8.300	0.1303	147	14.600
31	3.000	14.000	0.1306	255	25.400	-8.400	0.1303	148	14.700
32	3.100	13.900	0.1306	256	25.500	-8.500	0.1303	149	14.800
33	3.200	13.800	0.1306	257	25.600	-8.600	0.1303	150	14.900
34	3.300	13.700	0.1306	258	25.700	-8.700	0.1303	151	15.000
35	3.400	13.600	0.1306	259	25.800	-8.800	0.1303	152	15.100
36	3.500	13.500	0.1306	260	25.900	-8.900	0.1303	153	15.200
37	3.600	13.400	0.1306	261	26.000	-9.000	0.1303	154	15.300
38	3.700	13.300	0.1306	262	26.100	-9.100	0.1303	155	15.400
39	3.800	13.200	0.1306	263	26.200	-9.200	0.1303	156	15.500
40	3.900	13.100	0.1306	264	26.300	-9.300	0.1303	157	15.600
41	4.000	13.000	0.1306	265	26.400	-9.400	0.1303	158	15.700
42	4.100	12.900	0.1306	266	26.500	-9.500	0.1304	159	15.800
43	4.200	12.800	0.1306	267	26.600	-9.600	0.1303	160	15.900
44	4.300	12.700	0.1306	268	26.700	-9.700	0.1304	161	16.000
45	4.400	12.600	0.1306	269	26.800	-9.800	0.1303	162	16.100
46	4.500	12.500	0.1306	270	26.900	-9.900	0.1304	163	16.200
47	4.600	12.400	0.1306	271	27.000	-10.000	0.1304	164	16.300
48	4.700	12.300	0.1306	272	27.100	-10.100	0.1304	165	16.400
49	4.800	12.200	0.1306	273	27.200	-10.200	0.1304	166	16.500
50	4.900	12.100	0.1307	274	27.300	-10.300	0.1303	167	16.600
51	5.000	12.000	0.1307	275	27.400	-10.400	0.1304	168	16.700
52	5.100	11.900	0.1306	276	27.500	-10.500	0.1303	169	16.800
53	5.200	11.800	0.1306	277	27.600	-10.600	0.1304	170	16.900
54	5.300	11.700	0.1306	278	27.700	-10.700	0.1304	171	17.000
55	5.400	11.600	0.1306	279	27.800	-10.800	0.1304	172	17.100
56	5.500	11.500	0.1306	280	27.900	-10.900	0.1304	173	17.200
57	5.600	11.400	0.1306	281	28.000	-11.000	0.1304	174	17.300
58	5.700	11.300	0.1306	282	28.100	-11.100	0.1304	175	17.400

59	5.800	11.200	0.1306	283	28.200	-11.200	0.1304	176	17.500
60	5.900	11.100	0.1306	284	28.300	-11.300	0.1304	177	17.600
61	6.000	11.000	0.1306	285	28.400	-11.400	0.1304	178	17.700
62	6.100	10.900	0.1307	286	28.500	-11.500	0.1304	179	17.800
63	6.200	10.800	0.1307	287	28.600	-11.600	0.1304	180	17.900
64	6.300	10.700	0.1306	288	28.700	-11.700	0.1304	181	18.000
65	6.400	10.600	0.1306	289	28.800	-11.800	0.1304	182	18.100
66	6.500	10.500	0.1306	290	28.900	-11.900	0.1304	183	18.200
67	6.600	10.400	0.1306	291	29.000	-12.000	0.1304	184	18.300
68	6.700	10.300	0.1306	292	29.100	-12.100	0.1304	185	18.400
69	6.800	10.200	0.1306	293	29.200	-12.200	0.1304	186	18.500
70	6.900	10.100	0.1306	294	29.300	-12.300	0.1304	187	18.600
71	7.000	10.000	0.1306	295	29.400	-12.400	0.1304	188	18.700
72	7.100	9.900	0.1306	296	29.500	-12.500	0.1304	189	18.800
73	7.200	9.800	0.1306	297	29.600	-12.600	0.1304	190	18.900
74	7.300	9.700	0.1306	298	29.700	-12.700	0.1303	191	19.000
75	7.400	9.600	0.1306	299	29.800	-12.800	0.1303	192	19.100
76	7.500	9.500	0.1305	300	29.900	-12.900	0.1303	193	19.200
77	7.600	9.400	0.1305	301	30.000	-13.000	0.1304	194	19.300
78	7.700	9.300	0.1306	302	30.100	-13.100	0.1303	195	19.400
79	7.800	9.200	0.1305	303	30.200	-13.200	0.1303	196	19.500
80	7.900	9.100	0.1305	304	30.300	-13.300	0.1303	197	19.600
81	8.000	9.000	0.1306	305	30.400	-13.400	0.1303	198	19.700
82	8.100	8.900	0.1305	306	30.500	-13.500	0.1303	199	19.800
83	8.200	8.800	0.1305	307	30.600	-13.600	0.1303	200	19.900
84	8.300	8.700	0.1305	308	30.700	-13.700	0.1303	201	20.000
85	8.400	8.600	0.1305	309	30.800	-13.800	0.1303	202	20.100
86	8.500	8.500	0.1305	310	30.900	-13.900	0.1303	203	20.200
87	8.600	8.400	0.1305	311	31.000	-14.000	0.1303	204	20.300
88	8.700	8.300	0.1305	312	31.100	-14.100	0.1302	205	20.400
89	8.800	8.200	0.1305	313	31.200	-14.200	0.1302	206	20.500
90	8.900	8.100	0.1305	314	31.300	-14.300	0.1303	207	20.600
91	9.000	8.000	0.1305	315	31.400	-14.400	0.1302	208	20.700
92	9.100	7.900	0.1305	316	31.500	-14.500	0.1302	209	20.800
93	9.200	7.800	0.1305	317	31.600	-14.600	0.1302	210	20.900
94	9.300	7.700	0.1304	318	31.700	-14.700	0.1302	211	21.000
95	9.400	7.600	0.1304	319	31.800	-14.800	0.1302	212	21.100
96	9.500	7.500	0.1304	320	31.900	-14.900	0.1302	213	21.200
97	9.600	7.400	0.1304	321	32.000	-15.000	0.1302	214	21.300
98	9.700	7.300	0.1304	322	32.100	-15.100	0.1302	215	21.400
99	9.800	7.200	0.1304	323	32.200	-15.200	0.1302	216	21.500
100	9.900	7.100	0.1304	324	32.300	-15.300	0.1301	217	21.600
101	10.000	7.000	0.1304	325	32.400	-15.400	0.1302	218	21.700
102	10.100	6.900	0.1304	326	32.500	-15.500	0.1301	219	21.800
103	10.200	6.800	0.1304	327	32.600	-15.600	0.1301	220	21.900
104	10.300	6.700	0.1304	328	32.700	-15.700	0.1301	221	22.000
105	10.400	6.600	0.1303	329	32.800	-15.800	0.1302	222	22.100
106	10.500	6.500	0.1303	330	32.900	-15.900	0.1301	223	22.200
107	10.600	6.400	0.1303	331	33.000	-16.000	0.1301	224	22.300
108	10.700	6.300	0.1304	332	33.100	-16.100	0.1301		
109	10.800	6.200	0.1304	333	33.200	-16.200	0.1302		
110	10.900	6.100	0.1304	334	33.300	-16.300	0.1302		
111	11.000	6.000	0.1303	335	33.400	-16.400	0.1302		
112	11.100	5.900	0.1303	336	33.500	-16.500	0.1303		
113	11.200	5.800	0.1303	337	33.600	-16.600	0.1302		
114	11.300	5.700	0.1303	338	33.700	-16.700	0.1303		
115	11.400	5.600	0.1304	339	33.800	-16.800	0.1303		
116	11.500	5.500	0.1303	340	33.900	-16.900	0.1304		
117	11.600	5.400	0.1288	341	34.000	-17.000	0.1305		

absdist(mm	1st	2nd	3 rd
5.300	Run	Run	Run
5.200	Reading	Reading	Reading
5.100	Inches	Inches	Inches
5.000			
4.900			
4.800			
4.700	-0.00055		
4.600	-0.00010		
4.500	0.00055		
4.400	0.00075		
4.300	0.00020		
4.200	0.00010		
4.100	-0.00010		
4.000	-0.00015		
3.900	-0.00020		
3.800	-0.00015		
3.700	-0.00020		
3.600	-0.00020		
3.500	-0.00020		
3.400	-0.00020		
3.300	-0.00020		
3.200	-0.00020		
3.100	-0.00020		
3.000	-0.00015		
2.900	-0.00015		
2.800	-0.00015		
2.700	-0.00020		
2.600	-0.00020		
2.500	-0.00020		
2.400	-0.00020		
2.300	-0.00020		
2.200	-0.00020		
2.100	-0.00020		
2.000	-0.00020		
1.900	-0.00020		
1.800	-0.00020		
1.700	-0.00020		
1.600	-0.00020		
1.500	-0.00020		
1.400	-0.00020		
1.300	-0.00020		
1.200	-0.00020		
1.100	-0.00020		
1.000	-0.00020		
0.900	-0.00020		
0.800	-0.00020		
0.700	-0.00020		
0.600	-0.00025		
0.500	-0.00025		
0.400	-0.00020		
0.300	-0.00020		
0.200	-0.00020		
0.100	-0.00010		
0.000	-0.00010		
-0.100	-0.00010		
-0.200	-0.00015		
-0.300	-0.00015		
-0.400	-0.00015		

WeldedMoSmpHolder_No31 DONE!!

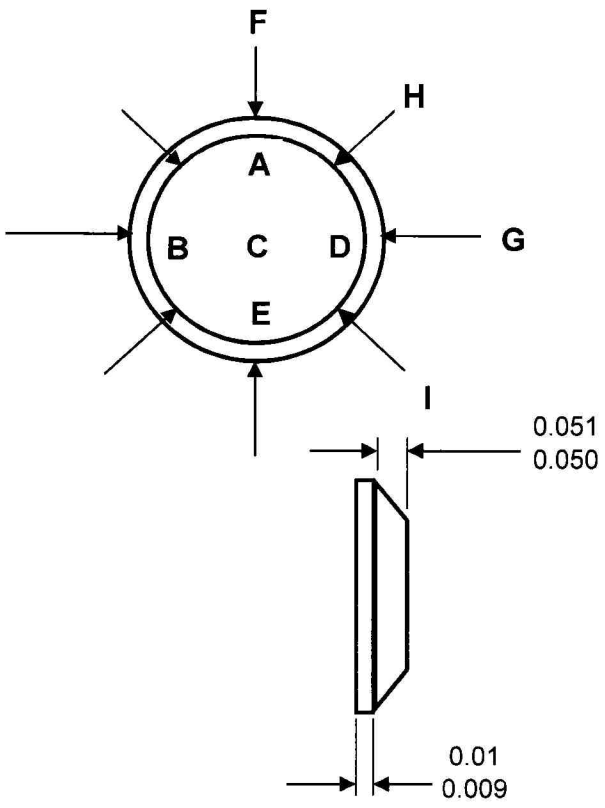
-0.500	-0.00020		
-0.600	-0.00015		
-0.700	-0.00020		
-0.800	-0.00020		
-0.900	-0.00015		
-1.000	-0.00015		
-1.100	-0.00020		
-1.200	-0.00020		
-1.300	-0.00020		
-1.400	-0.00020		
-1.500	-0.00020		
-1.600	-0.00020		
-1.700	-0.00020		
-1.800	-0.00020		
-1.900	-0.00020		
-2.000	-0.00020		
-2.100	-0.00020		
-2.200	-0.00020		
-2.300	-0.00020		
-2.400	-0.00020		
-2.500	-0.00020		
-2.600	-0.00025		
-2.700	-0.00020		
-2.800	-0.00025		
-2.900	-0.00020		
-3.000	-0.00020		
-3.100	-0.00025		
-3.200	-0.00025		
-3.300	-0.00020		
-3.400	-0.00020		
-3.500	-0.00025		
-3.600	-0.00025		
-3.700	-0.00025		
-3.800	-0.00025		
-3.900	-0.00025		
-4.000	-0.00025		
-4.100	-0.00025		
-4.200	-0.00025		
-4.300	-0.00020		
-4.400	0.00045		
-4.500	0.00060		
-4.600	0.00005		
-4.700	-0.00035		
-4.800	-0.00050		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			

SHOT No.

FLYER PLATE MATERIAL: **molybdenum (8-1.55mm) - GM-LT**

Measurement done by: Russ

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06060	F	0.98450
A	0.06080	F	0.98450
B	0.06090	G	0.98450
B	0.06095	G	0.98450
C	0.06095	H	0.92700
C	0.06095	H	0.92700
D	0.06085	I	0.92700
D	0.06085	I	0.92700
E	0.06110		
E	0.06110		



Statistic for thickness

N	10
MAX	0.06110
MIN	0.06060
Range	0.00050
MEAN	0.06091
STDEV	0.000146154

Statistic for Diameter (F-G)

N	4
MAX	0.98450
MIN	0.98450
Range	0.00000
MEAN	0.9845000
STDEV	0

Statistic for Diameter (H-I)

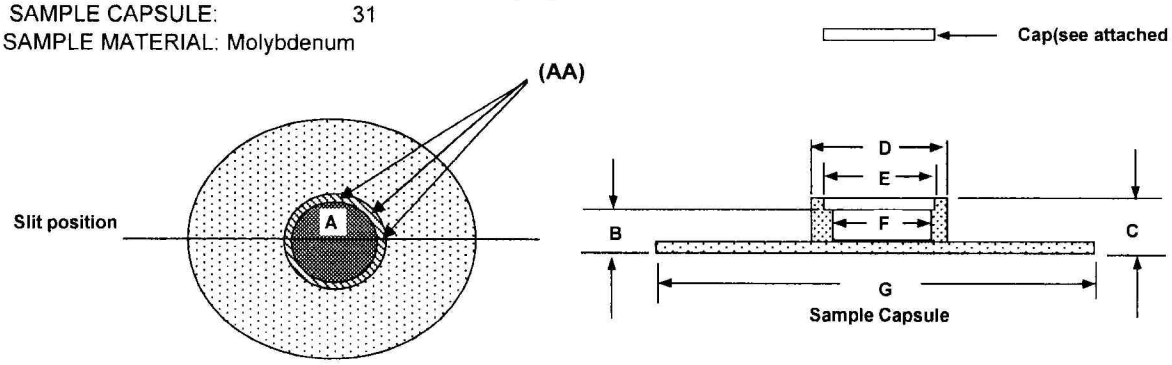
N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927
STDEV	0

DENSITY MEASUREMENT BY:			Russ			
NO. OF TRIAL	TEMP	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1			7.2136			10.237
2			7.2136			10.228
3			7.2135			10.238
	THICKNESS		0.060905	±	in	
	FLATNESS:		0.00050	in.		
	VOLUME:		0.7598	3.71E-04	cm^3	
	CRYSTAL DENSITY:		10.2343	5.51E-03	$grams/cm^3$	
	BULK DENSITY:		9.4946	3.76E-04	$grams/cm^3$	
	DENSITIES CHECKED BY: _____ on _____					
	MEASUREMENT CHECKED BY: _____ on _____					

SHOT No.: 466 prepolish 11/18/2010

SAMPLE CAPSULE: 31

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04095
A	0.04140
A	0.04110
A	0.04130
Avg	0.04119

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17195
C	0.17205
C	0.17190
C	0.17185
D	0.3965
D	0.3960

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14210
B point 2	0.14215
B point 3	0.14225
B point 4	0.14220
B point 5	0.14215
B point 6	0.14210
B point 7	0.14205
B point 8	0.14205

Statistics

N	8
MAX	0.14225
MIN	0.14205
Range	0.00020
Average	0.14213

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3545
E	0.3540
F	0.3145
F	0.3135
G	1.3595
G	1.3595
H	0.10094

MEASUREMENT BY:		Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

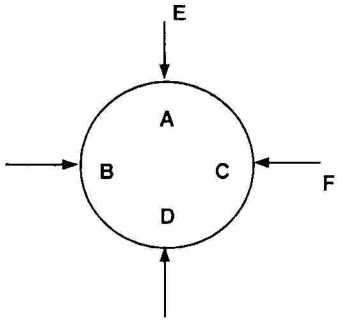
SHOT No. _____466_____

LGG Moly Capsule Cap 11/18/2010

SAMPLE MATERIAL: Mo 31

Post polish

Thickness Measurement	
A	0.02990
A	0.03005
B	0.03005
B	0.03000
C	0.03010
C	0.03010
D	0.03000
D	0.03000



Diameter Measurement	
E	0.35350
E	0.35400
F	0.35400
F	0.35350
AVE	0.35375
Radius	0.1769

Statistic for thickness	
N	8
MAX	0.03010
MIN	0.0299
Range	0.0002
MEAN	0.03003
STDEV	6.54654E-05

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.35375
STDEV	0.000288675

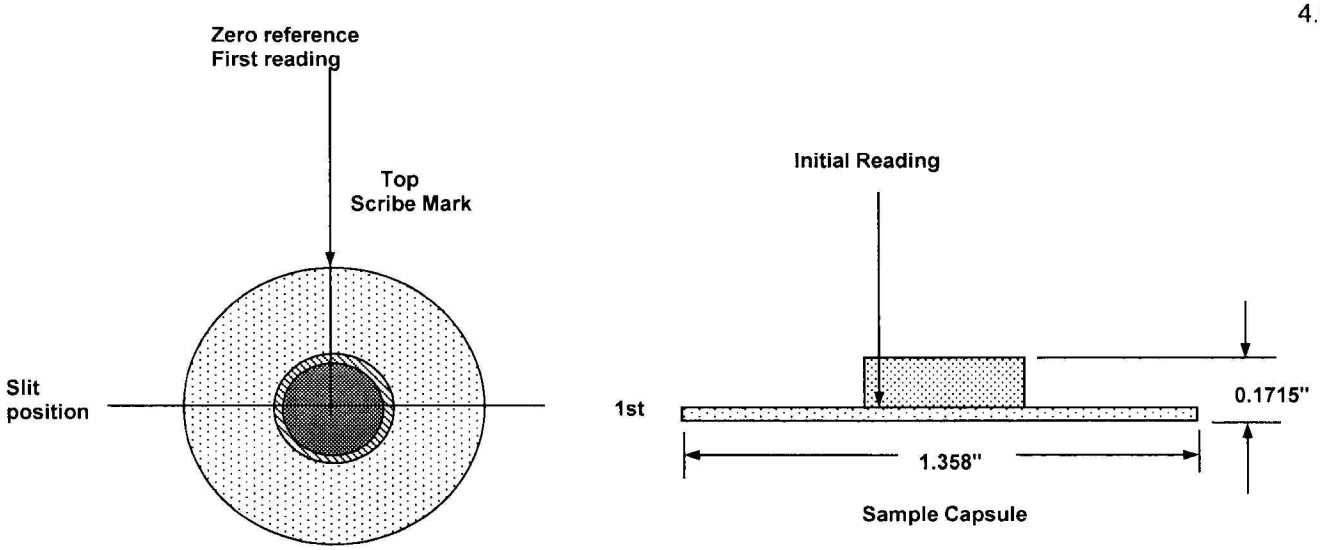
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.030025	±	mm	
	FLATNESS:		0.0002			
	VOLUME:		0.0484		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.2830		$grams/cm^3$	

SAMPLE CAPSULE: **31**
SAMPLE MATERIAL: **Molybdenum**

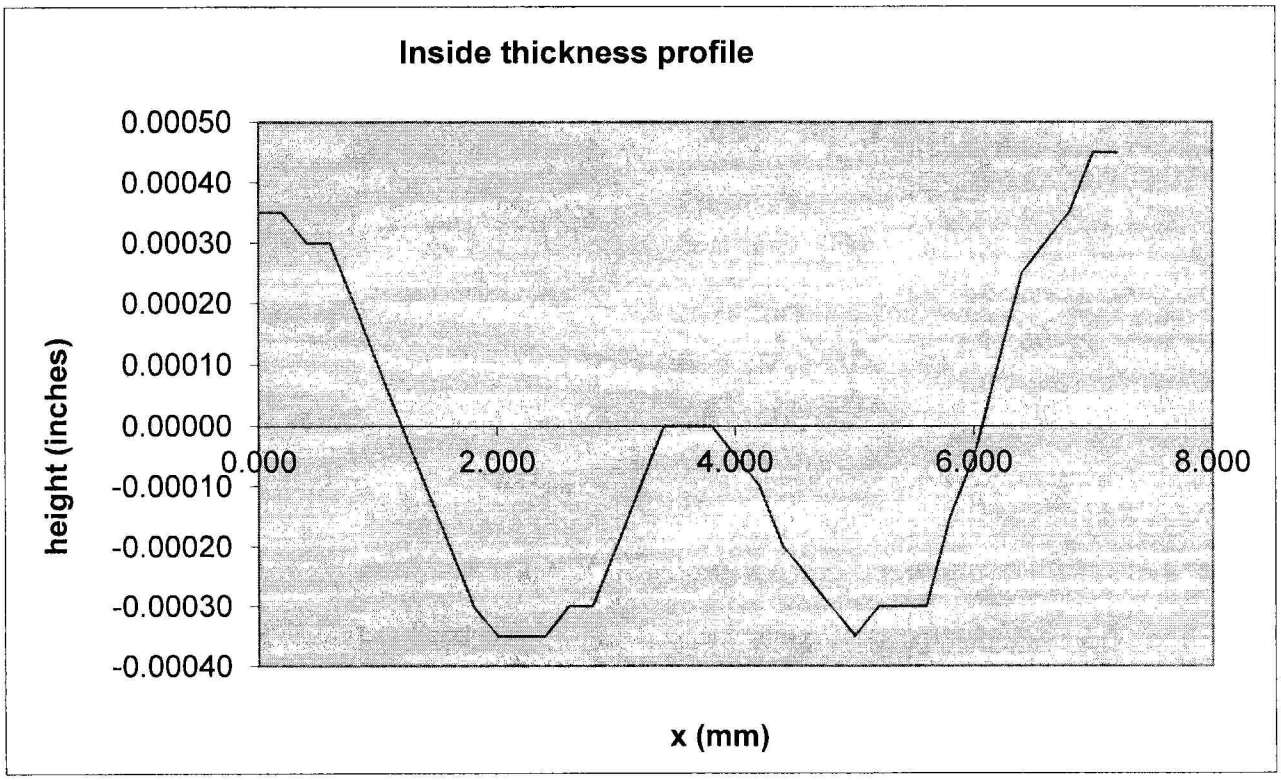
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.683
4.623



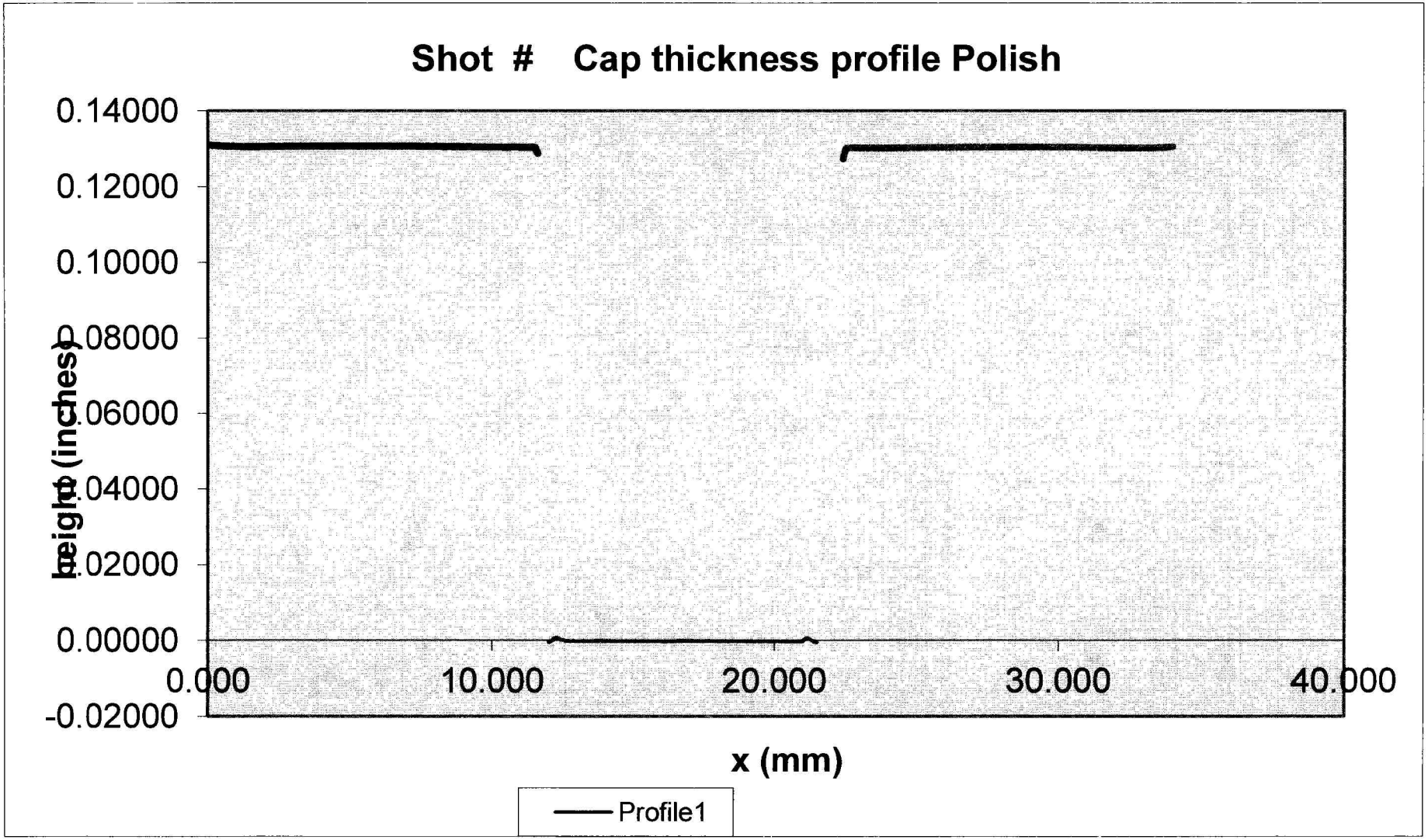
Average thickness reading = -0.00004

Note: The thickness of the reference zero point from the base is = **0.04200** Inches
1.0668 mm

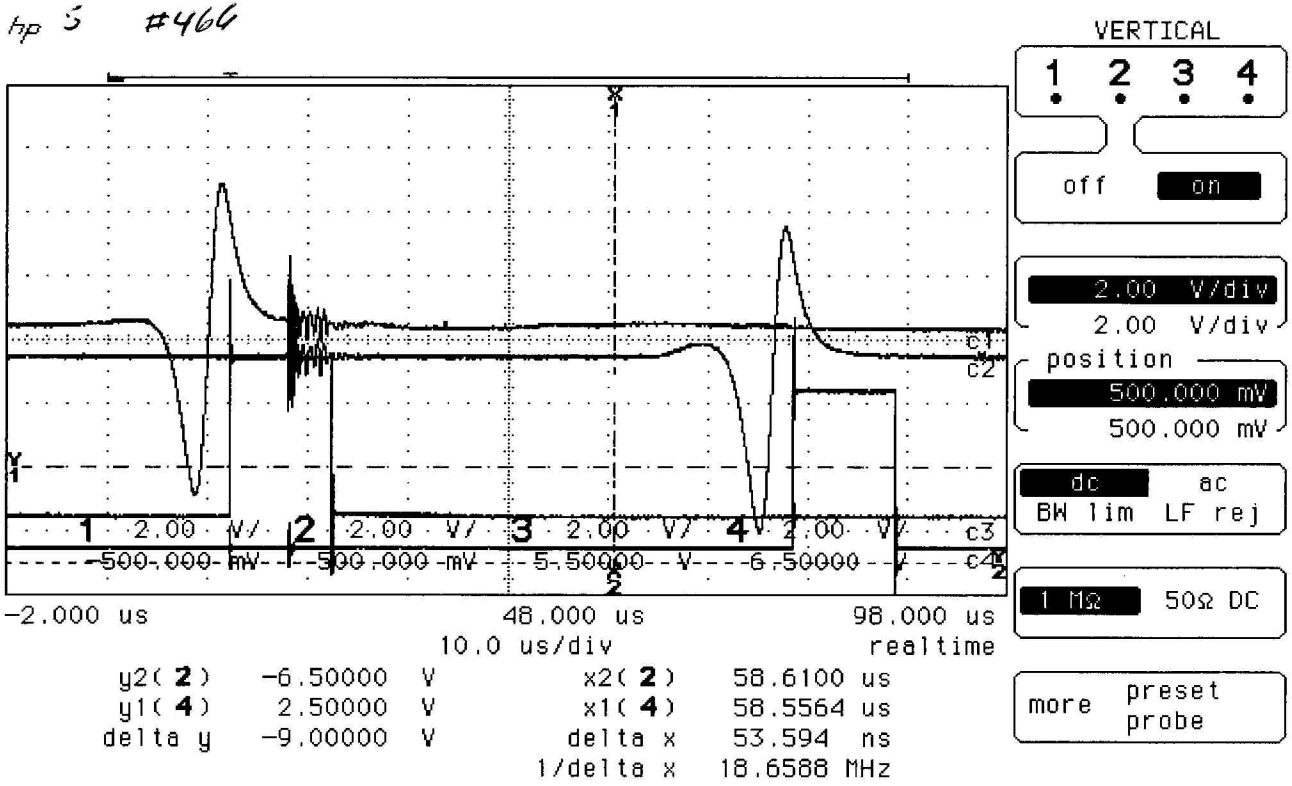


Thickness Measurement of the Sample
Holder (Slit Position) with 0.200 MM increment

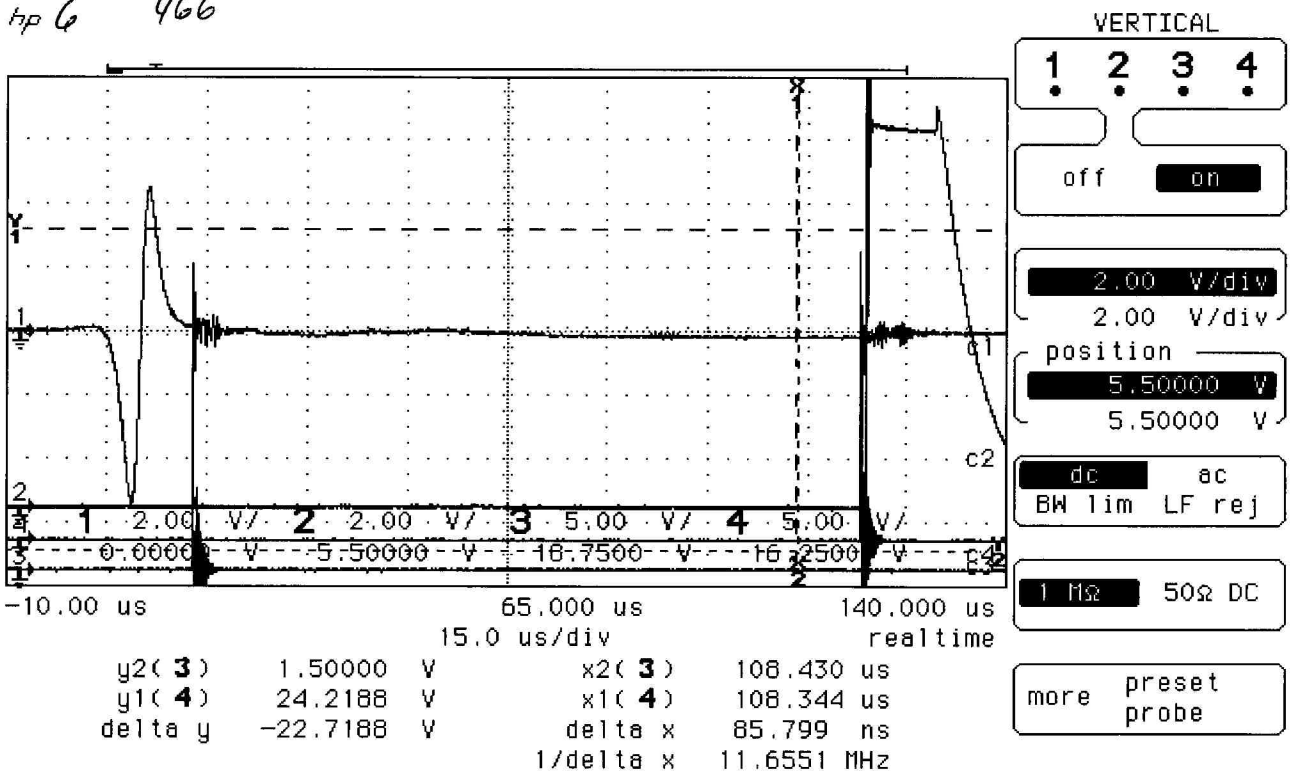
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00035	3.6	south
2	0.200	0.00035	3.40	
3	0.400	0.00030	3.20	
4	0.600	0.00030	3.00	
5	0.800	0.00020	2.80	
6	1.000	0.00010	2.60	
7	1.200	0.00000	2.40	
8	1.400	-0.00010	2.20	
9	1.600	-0.00020	2.00	
10	1.800	-0.00030	1.80	
11	2.000	-0.00035	1.60	
12	2.200	-0.00035	1.40	
13	2.400	-0.00035	1.20	
14	2.600	-0.00030	1.00	
15	2.800	-0.00030	0.80	
16	3.000	-0.00020	0.60	
17	3.200	-0.00010	0.40	
18	3.400	0.00000	0.20	
19	3.600	0.00000	0.00	
20	3.800	0.00000	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00010	-0.60	
23	4.400	-0.00020	-0.80	
24	4.600	-0.00025	-1.00	
25	4.800	-0.00030	-1.20	
26	5.000	-0.00035	-1.40	
27	5.200	-0.00030	-1.60	
28	5.400	-0.00030	-1.80	
29	5.600	-0.00030	-2.00	
30	5.800	-0.00015	-2.20	
31	6.000	-0.00005	-2.40	
32	6.200	0.00010	-2.60	
33	6.400	0.00025	-2.80	
34	6.600	0.00030	-3.00	
35	6.800	0.00035	-3.20	
36	7.000	0.00045	-3.40	
37	7.200	0.00045	-3.60	north


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
Height (inches)
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1

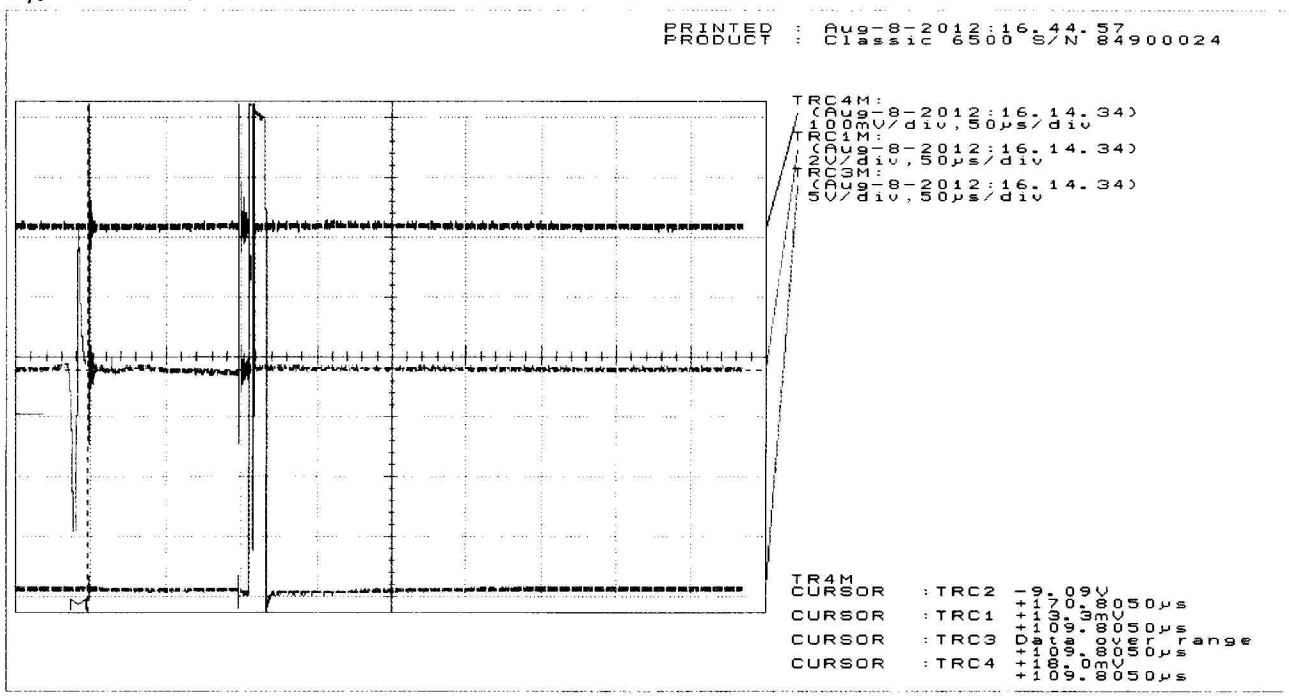
hp 5 #466


VERTICAL
1 2 3 4
off on
2.00 V/div
2.00 V/div
position
500.000 mV
500.000 mV
dc ac
BW lim LF rej
1 MΩ 50Ω DC
more preset probe
c1
c2
c3
c4
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/
-500.000 mV -500.000 mV -5.50000 V -6.50000 V
-2.000 us
48.000 us
98.000 us
10.0 us/div
realtime
y2(2) -6.50000 V
y1(4) 2.50000 V
delta y -9.00000 V
x2(2) 58.6100 us
x1(4) 58.5564 us
delta x 53.594 ns
1/delta x 18.6588 MHz

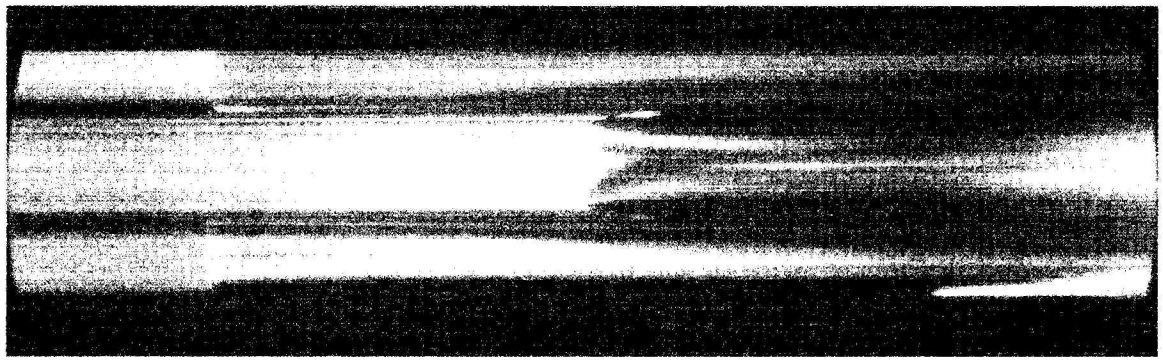
hp 6 #466


VERTICAL
1 2 3 4
off on
2.00 V/div
2.00 V/div
position
5.50000 V
5.50000 V
dc ac
BW lim LF rej
1 MΩ 50Ω DC
more preset probe
1 2.00 V/ 2 2.00 V/ 3 5.00 V/ 4 5.00 V/
0.0000 V -5.50000 V 16.7500 V 16.2500 V
c1
c2
-10.00 us
65.000 us
140.000 us
15.0 us/div
realtime
y2(3) 1.50000 V
y1(4) 24.2188 V
delta y -22.7188 V
x2(3) 108.430 us
x1(4) 108.344 us
delta x 85.799 ns
1/delta x 11.6551 MHz

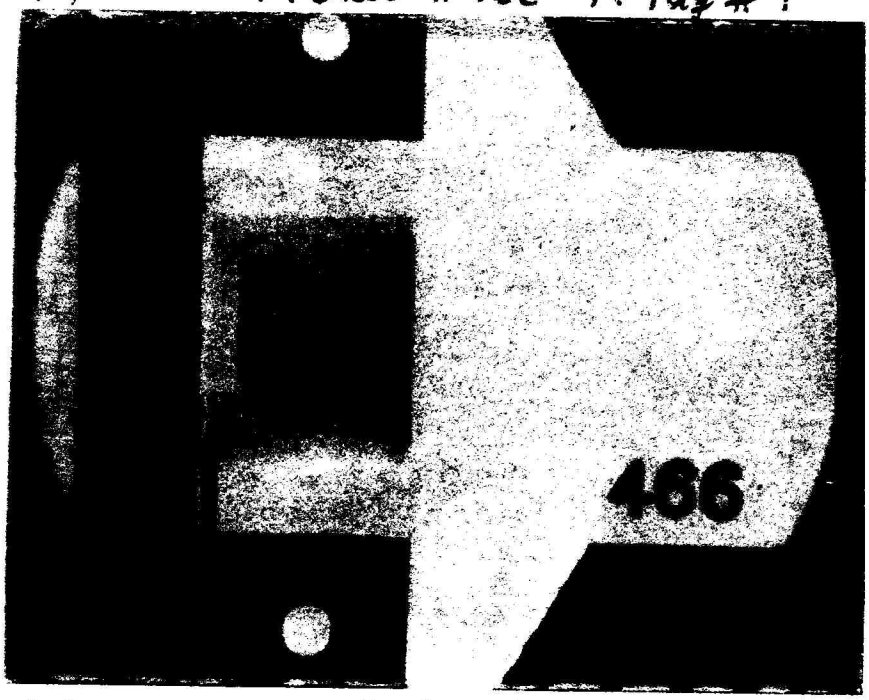
GS7 #466


PRINTED : Aug-8-2012:16.44.57
PRODUCT : Classic 6500 S/N 84900024
TRC4M:
(Aug-8-2012:16.14.34)
100mV/div,50µs/div
TRC1M:
(Aug-8-2012:16.14.34)
2V/div,50µs/div
TRC3M:
(Aug-8-2012:16.14.34)
5V/div,50µs/div
TR4M
CURSOR :TRC2 -9.09V
+170.8050µs
CURSOR :TRC1 +13.3mV
+109.8050µs
CURSOR :TRC3 Data over range
+109.8050µs
CURSOR :TRC4 +18.0mV
+109.8050µs

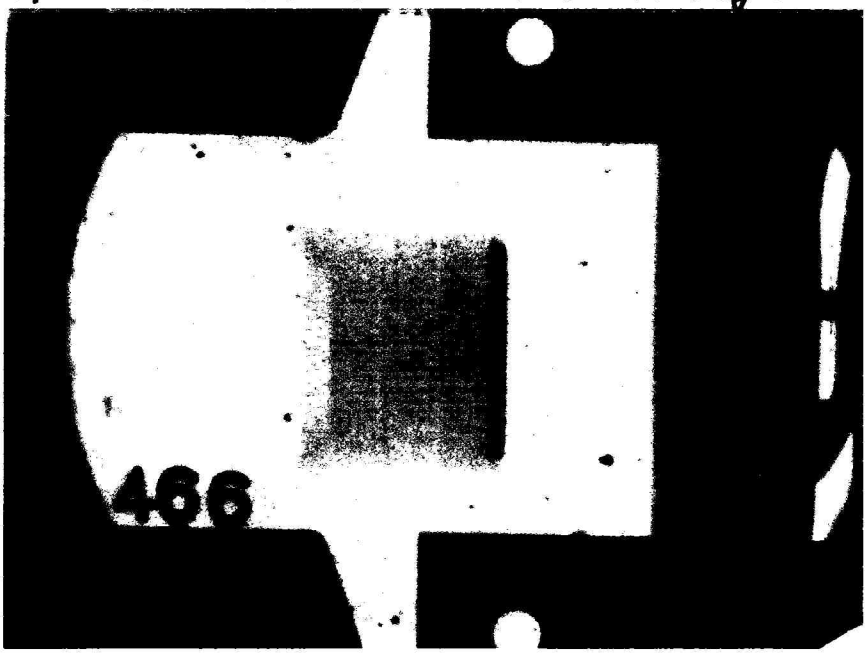
#466



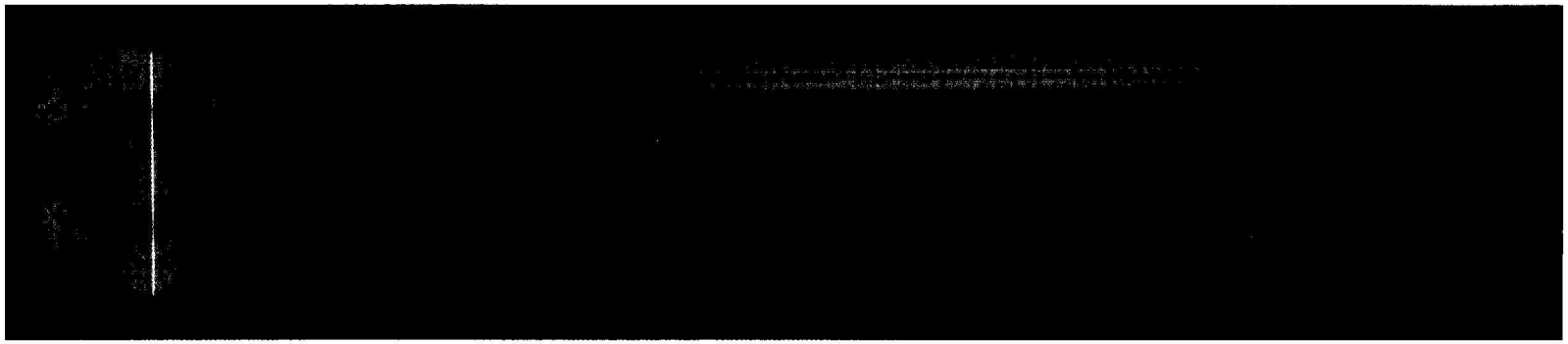
8/8/2012 LGG shot #466 X-ray #1



8/8/2012 LGG shot #466 X-ray #2



#466



LIGHT GAS GUN DATA SHEET

Shot No. 468 Date 8/17/12

Target:

Sample Material An-Hd-Di (#36) Crystallographic orientation —

Source Location U-Mich R. Lange Thickness:1 — in.

Type of Measurement Pre-heated EOS (1400°C) 2. — in.

Bulk Density _____ gm/cc Crystal Density — gm/cc

±2 std. devs. _____ gm/cc ±2 std. devs. — gm/cc

Total Shorting Pin Height _____ in. (shim to driver) Driver Plate Thickness _____ in.

Material Mo

Projectile:

Weight 20.0700 gms. Length 0.9065 in. Skirt Diameter 1.11310 in.

Flyer Plate Material Mo (#3) Leading Edge Dia. 1.1007 in.

Thickness 0.06118 in. Major Dia. 0.9848 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. Pressure 150 lbs

Temp 21°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.109 in.

Diameter: Front 3.496 in. Back 3.498 in.

Pump Tube:

Pre-Fill Pressure _____ in. Hg Fill Pressure _____ psig.

Powder Charge:

Main Charge 387 gms. Type IMR 4350 Total Charge 399 gms.

Primer Charge 12 gms. Type IMR4350

Expected Velocity:

Projectile 3.5 km/sec Piston _____ km/sec

Notes:

L.G.G.

Camera Streak Duration: 1512 nsec Timing calibration frequency: 147.8950/ MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1_____ µsec Flash X-ray #2_____µsec

Static Streak Photo _____ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0558 in. min. 0.0929 in. min.

0.0566 in. max. 0.0939 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 103/109 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	673 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1366 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	58.2 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	100.231 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	111.428 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	11.201 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	100.232 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	58.24 µsec
UDC Velocity:			3495.98 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	273.60 ns
HP5, 2:	Velocity magnet 2	58.4944 µsec
HP5, 3:	TTL Start	2.25170 µsec
HP5, 4:	TTL Stop	60.4722 µsec
HP6, 1:	Velocity Magnet 1	251.20 ns
HP6,2:	Xenon Lamp Trigger	112.7584 sec
HP6, 3:	X-ray 1 Pulser Monitor Out	8.1256 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	108.35580 µsec
GS7, 1:	Velocity Magnet 1	−660-8 ns
GS7,3:	Camera Trigger (UDC HV 1)	118.2120 µsec
GS7, 4:	Camera Monitor Out	118.4272 µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	60.100 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	100.392 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	115.087 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	14.699 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	100.413 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	60.060 µsec
UDC Velocity:			3390.04 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	456.2	ns
HP5, 2:	Velocity magnet 2	60.533	µsec
HP5, 3:	TTL Start	2.458	µsec
HP5, 4:	TTL Stop	62.520	µsec
HP6, 1:	Velocity Magnet 1	415.0	ns
HP6,2:	Xenon Lamp Trigger	116.606	µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	8.301	µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	108.712	µsec
GS7, 1:	Velocity Magnet 1	139.552	µsec
GS7, 2:	Camera Cal. Sig.	262.783	µsec
GS7,3:	Camera Trigger (UDC HV 1)	262.104	µsec
GS7, 4:	Camera Monitor Out	262.320	µsec

Shot 468 Nominal Timeline Preshot

V	3500			meters	mag SIM time	58173	ns
cable time	90	150	M1-M2 distance	0.203606			
intervalometer intrinsic delay	[redacted]		M2-target distance	0.215786			
UDC extra count lag	[redacted]		M2-target fudge	[redacted]			
pulse translator delay	150		M1-fid1 distance	0.03			
X-ray 1 program delay	[redacted]	5279 X-ray 1 actual delay	M1-fid2 distance	0.383145			
X-ray 2 program delay	[redacted]	106177 X-ray 2 actual delay	Flyer thickness	0.00155397			
X-ray 1 pulser delay	600						
X-ray 2 pulser delay	[redacted]		Us(Mo)	7210.00583			
Camera intrinsic delay	107		driver thickness	0.00102616			
Lamp trigger to peak brightness	7127		cap thickness	0.0007808			
HV#3 delay to lamp	-6370		estimated sample+cover time	258.969506			
Streak duration	1514						
Desired dead streak before driver	500						

	rho0	Co	s			
Cold Mo	10206	5033	1.28946405			
Hot Mo	9937	4918.5831	1.28837124	1407		
Liquid An-Di-H	[redacted]					

				up	P	Us
driver	357.7250824	-192364649	3.40997E+11	1778.54228	127.425134	7210.00583
sample	8929.672302	-147747174	3.35845E+11	2720.37903	49.8575432	6693.77614
cap	-8929.6723	-98810431	1.57037E+11	1409.68863	94.3413846	6734.78538

t (ns)	flyer x (m)	shock front (m)	event
0	0.00077699		M1 zero-crossing
150	0.00130199		HP5-1, GS7-1, HP6-1, Intervalometer start
2230	0.00858199		HP5-3, UDC start, signal to pulse translator
2380	0.00910699		pulse translator out
7659	0.02758349		X-ray 1 delay amp out to counters 4, 5
8349	0.02999849		X-ray 1 fires
8439	0.03031349		X-ray 1 pulse monitor at counter 4b
58173	0.20438299		M2 zero-crossing
58323	0.20490799		HP5-2, Intervalometer stop
60403	0.21218799		HP5-4, UDC stop
108557	0.38072649		X-ray 2 delay amp, stop counter 4, start counter 5
109272	0.38322899		X-ray 2 fires
109362	0.38354399		X-ray 2 pulse monitor at counter 4b
119050	0.41745064		UDC out, GS7-3, stop counters 5 and 6
119140	0.41776564		Trigger at camera
119247	0.41814014		Begin Streak
119337	0.41845514		Camera Monitor on GS7-4
119604	0.419392	0	IMPACT
119747		0.00102616	Driver arrival on streak
120006		0.002893332	Sample cutoff on streak
120761		0.008337106	End Streak

			X-ray velocity		3500
					On film
X-ray 1 flyer vs. fid (mm)			-0.001514		-0.0017605
Counter 3:	58173				
			HP5 2-1		58173
UDC upcount:	58173		HP5 4-3		58173
Counter 4:	100898				
X-ray 2 flyer vs. fid (mm)			0.083986		0.09765814
Counter 4b:	100923				
Counter 5:	111391		GS7 3-1		118900
Counter 6:	10493		GS7 4-1		119187
			HP6-1		

		scopes			
trig		HP5-1	0	10V pp	rising
		HP5-2	58173	10V pp	rising
		HP5-3	2080	5 V _-_	
		HP5-4	60253	5 V _-_	
trig		HP6-1	\ 0	10V pp	rising
HV#1-14.3us		HP6-2	112680	10 V _-_	
		HP6-3	8289	25 V /\	
		HP6-4	109212	25 V /\	
trig		GS7-1	0	10V pp	rising
sim only		GS7-2	119550	10 V _-_	ttl
		GS7-3	118900	40 V _-_	
		GS7-4	119187	(-)1.75 V	down going

Driver cutoff on streak	500
Sample cutoff on streak	759

200 ns/div
- 20 μs
500 ns/div
- 20 μs
50 μs

MAGNET DISTANCE

Shot No. **468** Expected Velocity: **3.50**

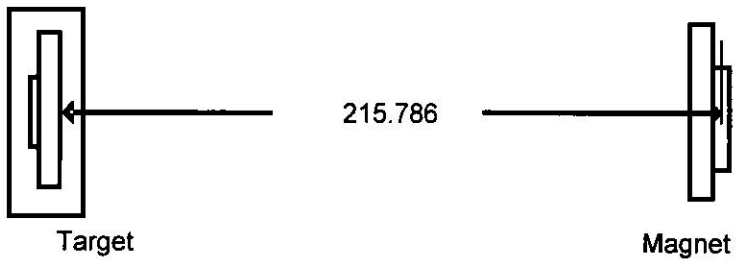
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **58.173 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.370 inch

Second measurement = 8.371 inch

Average measurement = 8.371 inch

Average measurement = 212.611 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

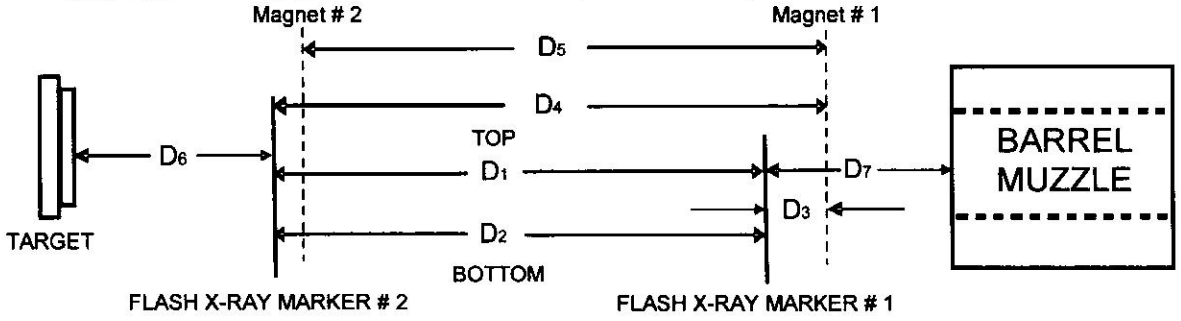
Distance Between Magnet # 2 to Target = 215.786 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **61.653 µsec.**

Fudged Distance between Magnet 2 to Target = 205.845 mm

TARGET MEASUREMENT

Shot No. **468** Expected Velocity: **3.50** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	8.375	99.0
Measure # 2, mm	30.00	383.15	203.66	8.377	99.0
Average, mm	30.00	383.15	203.61	8.376	99.0
Travel time, µsec	**8.57**	**109.47**	**58.17**	**2.39**	**28.29**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **100.92** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **100.88** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **5.47** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **106.82** µsec.

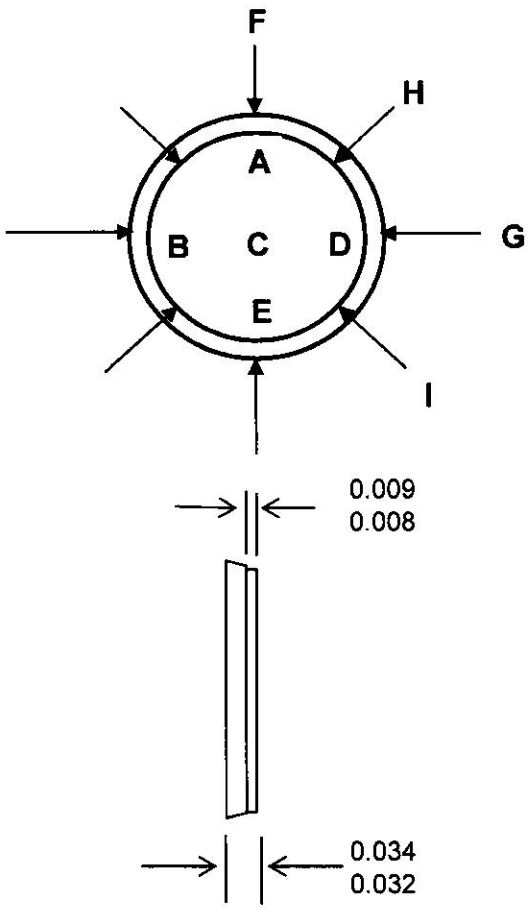
sheet values
5279 ns
106177 ns

SHOT No.

FLYER PLATE MATERIAL: **Mo 3** 7/5/2012

Measurement done by: Emma

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06110	F	0.98600
A	0.06110	F	0.98450
B	0.06120	G	0.98450
B	0.06120	G	0.98450
C	0.06125	H	0.92700
C	0.06120	H	0.92700
D	0.06110	I	0.92700
D	0.06110	I	0.92700
E	0.06125		
E	0.06130		



Statistic for thickness

N	10
MAX	0.06130
MIN	0.06110
Range	0.00020
MEAN	0.06118
	1.553972 mm
STDEV	7.52773E-05

Statistic for Diameter (F-G)

N	4
MAX	0.98600
MIN	0.98450
Range	0.00150
MEAN	0.9848750 inch
	25.0158250 mm
STDEV	0.00075

Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927 inch
	23.5458 mm
STDEV	0

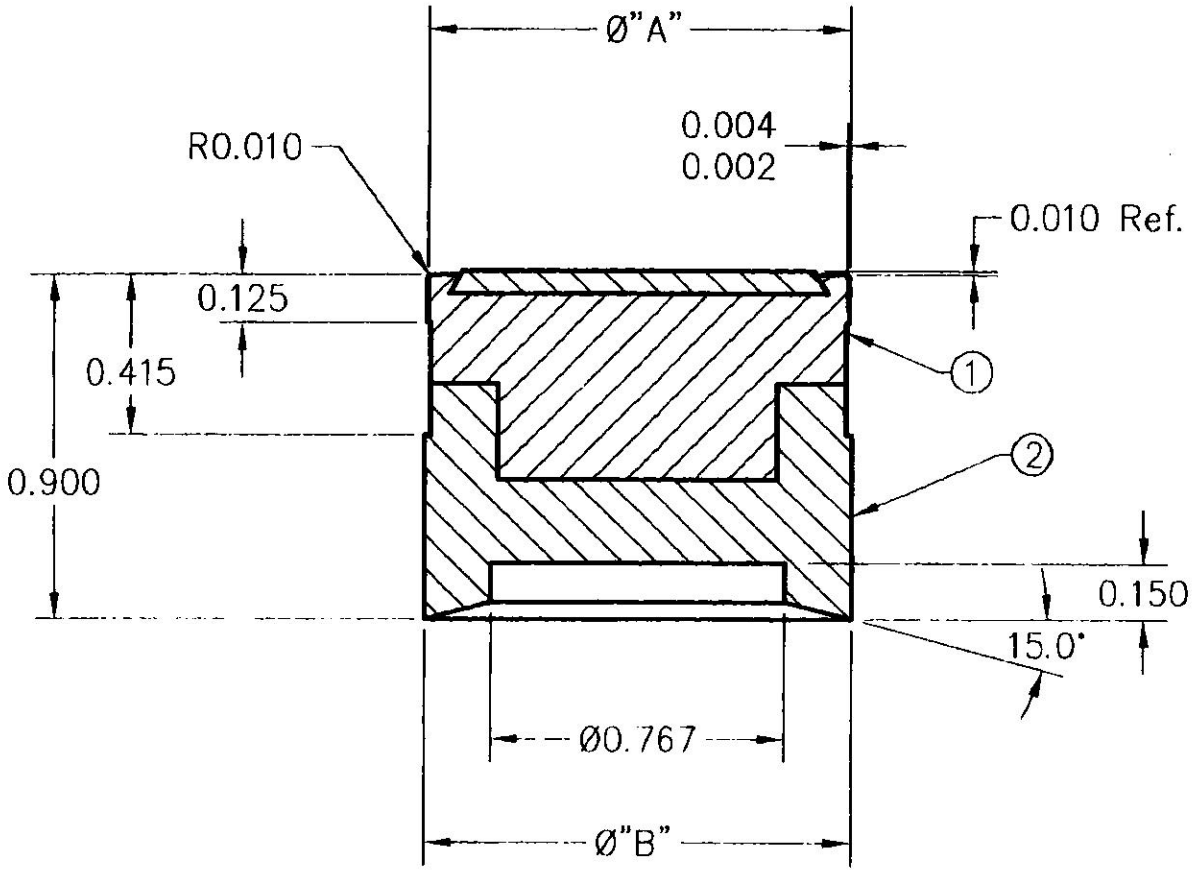
	Sample in Air	Crystal Density	
1	7.24028	10.21	
2	7.23997	10.22	
3	7.23989	10.22	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.06118	±	in
FLATNESS:	0.00020	in.	
VOLUME:			cm^3
CRYSTAL DENSITY:	10.2197		$grams/cm^3$
BULK DENSITY:	#DIV/0!		$grams/cm^3$

DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED B Emma 7/5/2012



FLYER #3mc

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-128	1
1	Sabot & Flyer Plate	LGG-157	1

BUILT AS — SHOT# 468

1.1007	A	1.1007	+.0000 -.0005
1.11310	B	1.1125	+.0005 -.0000

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN: M. Long — DATE: 11/29/10
ENGINEER — DATE
APPROVED — DATE

MATERIAL: Zelux-M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy. for 28mm launch tube (GM)

SCALE: 2:1 — SHEET: 2 of 2 — A — DRAWING NUMBER: LGG-158

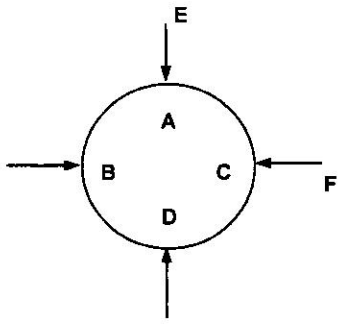
SHOT No. _____468_____

LGG Moly Capsule Cap 11/24/2010

SAMPLE MATERIAL: Mo 36

Post polish

	Thickness Measurement
A	0.03065
A	0.03070
B	0.03070
B	0.03075
C	0.03075
C	0.03075
D	0.03075
D	0.03085



	Diameter Measurement
E	0.35300
E	0.35300
F	0.35350
F	0.35350
AVE	0.35325
Radius	0.1766

Statistic for thickness	
N	8
MAX	0.03085
MIN	0.0307
Range	0.0002
MEAN	0.03074
STDEV	5.82482E-05

Statistic for perimeter	
N	4
MAX	0.35350
MIN	0.353
Range	0.0005
MEAN	0.35325
STDEV	0.000288675

post-polish:

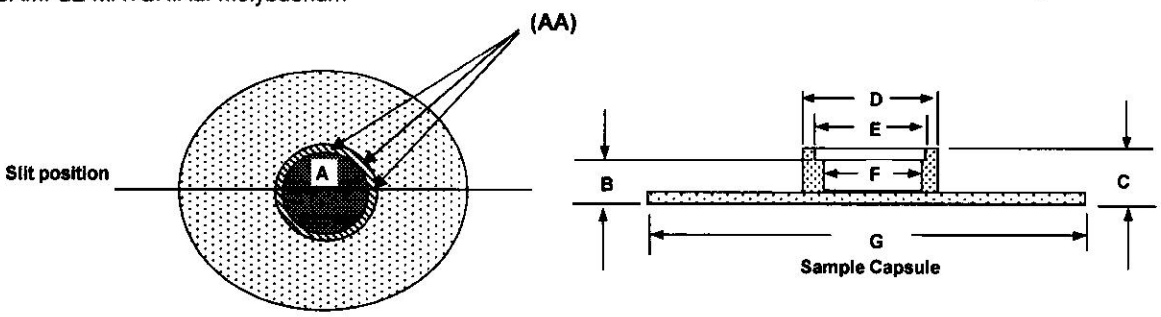
DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.0307375	±	mm	
	FLATNESS:		0.0002			
	VOLUME:		0.0494		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.0731		$grams/cm^3$	

SHOT No.: 468 prepolish 11/18/2010

SAMPLE CAPSULE: 36

SAMPLE MATERIAL: Molybdenum

Cap(see attached sheet)



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04080
A	0.04080
A	0.04095
A	0.04085
Avg	0.04085

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17110
C	0.17110
C	0.17130
C	0.17100
D	0.3960
D	0.3955

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14195
B point 2	0.14165
B point 3	0.14265
B point 4	0.14250
B point 5	0.14230
B point 6	0.14190
B point 7	0.14205
B point 8	0.14155

Statistics

N	8
MAX	0.14265
MIN	0.14155
Range	0.00110
Average	0.14207

DIGITAL CALIFER DIAMETER MEASUREMENT

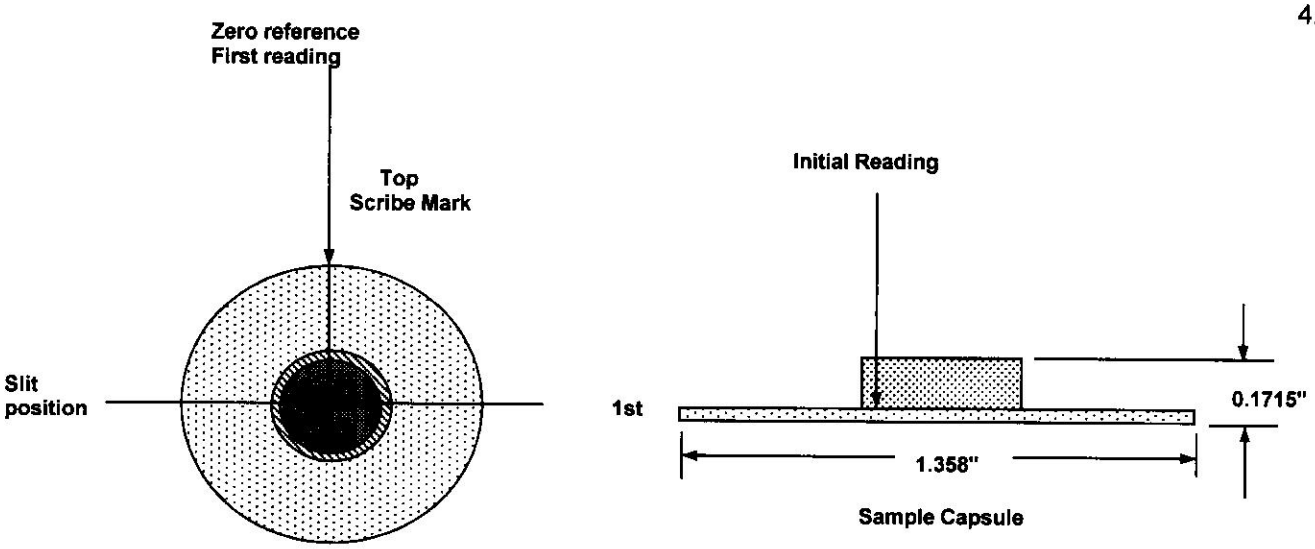
E	0.3535
E	0.3535
F	0.3140
F	0.3135
G	1.3590
G	1.3590
H	0.10122

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SAMPLE CAPSULE: **36**
SAMPLE MATERIAL: **Molybdenum**

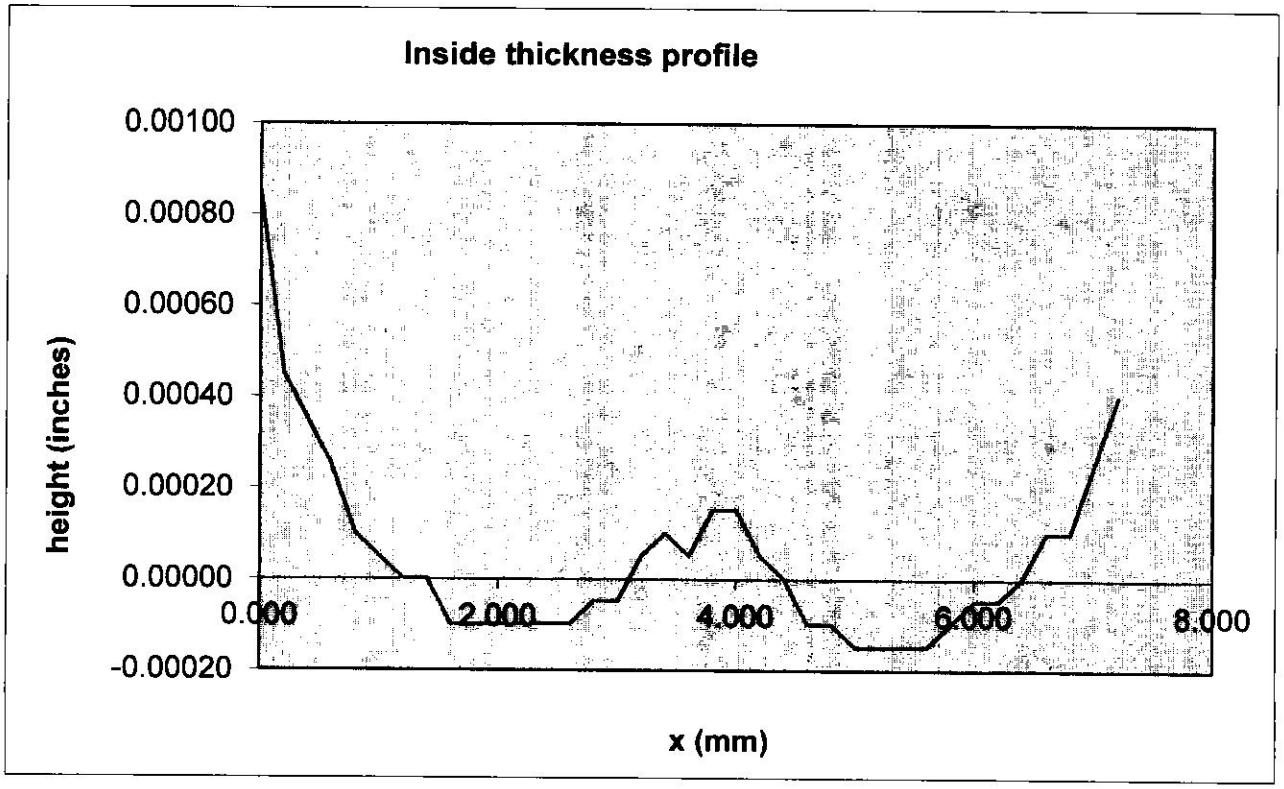
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.683
4.623



Average thickness reading = 0.00005

Note: The thickness of the reference zero point from the base is = **0.04555** Inches
1.15697 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00085	3.6	south
2	0.200	0.00045	3.40	
3	0.400	0.00035	3.20	
4	0.600	0.00025	3.00	
5	0.800	0.00010	2.80	
6	1.000	0.00005	2.60	
7	1.200	0.00000	2.40	
8	1.400	0.00000	2.20	
9	1.600	-0.00010	2.00	
10	1.800	-0.00010	1.80	
11	2.000	-0.00010	1.60	
12	2.200	-0.00010	1.40	
13	2.400	-0.00010	1.20	
14	2.600	-0.00010	1.00	
15	2.800	-0.00005	0.80	
16	3.000	-0.00005	0.60	
17	3.200	0.00005	0.40	
18	3.400	0.00010	0.20	
19	3.600	0.00005	0.00	
20	3.800	0.00015	-0.20	
21	4.000	0.00015	-0.40	
22	4.200	0.00005	-0.60	
23	4.400	0.00000	-0.80	
24	4.600	-0.00010	-1.00	
25	4.800	-0.00010	-1.20	
26	5.000	-0.00015	-1.40	
27	5.200	-0.00015	-1.60	
28	5.400	-0.00015	-1.80	
29	5.600	-0.00015	-2.00	
30	5.800	-0.00010	-2.20	
31	6.000	-0.00005	-2.40	
32	6.200	-0.00005	-2.60	
33	6.400	0.00000	-2.80	
34	6.600	0.00010	-3.00	
35	6.800	0.00010	-3.20	
36	7.000	0.00025	-3.40	
37	7.200	0.00040	-3.60	north

SHOT No. _____468_____ tip used: .7mm long/ flat tip

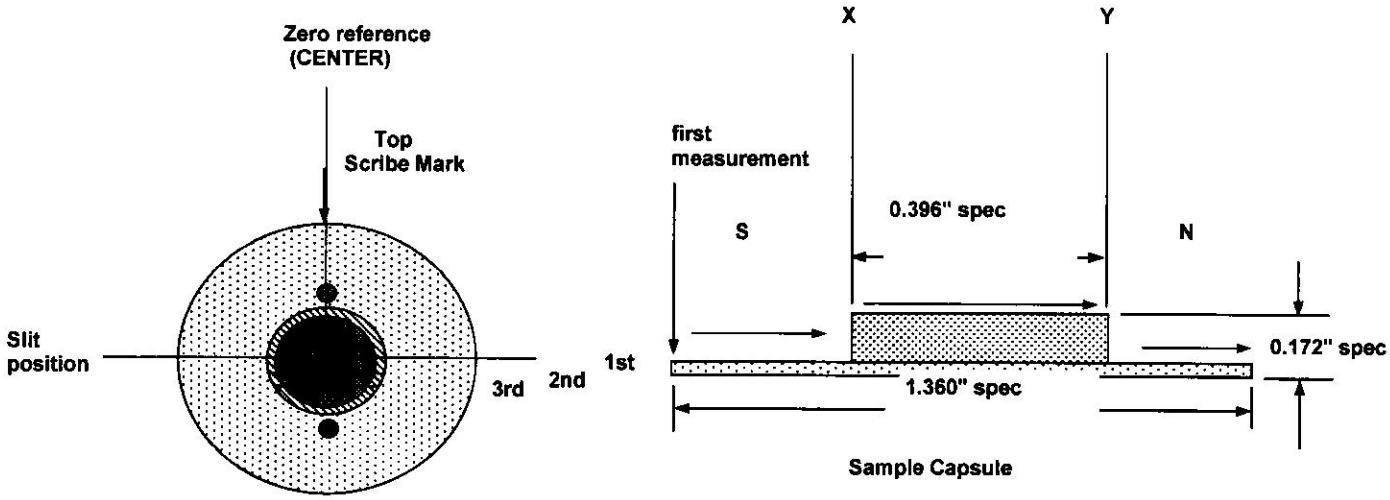
SAMPLE CAPSULE: 36

SAMPLE MATERIAL: An-Di-Hd

direction of measurement

5.355

THICKNESS PROFILE (Not re-polished, but final surface) 2.0475



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

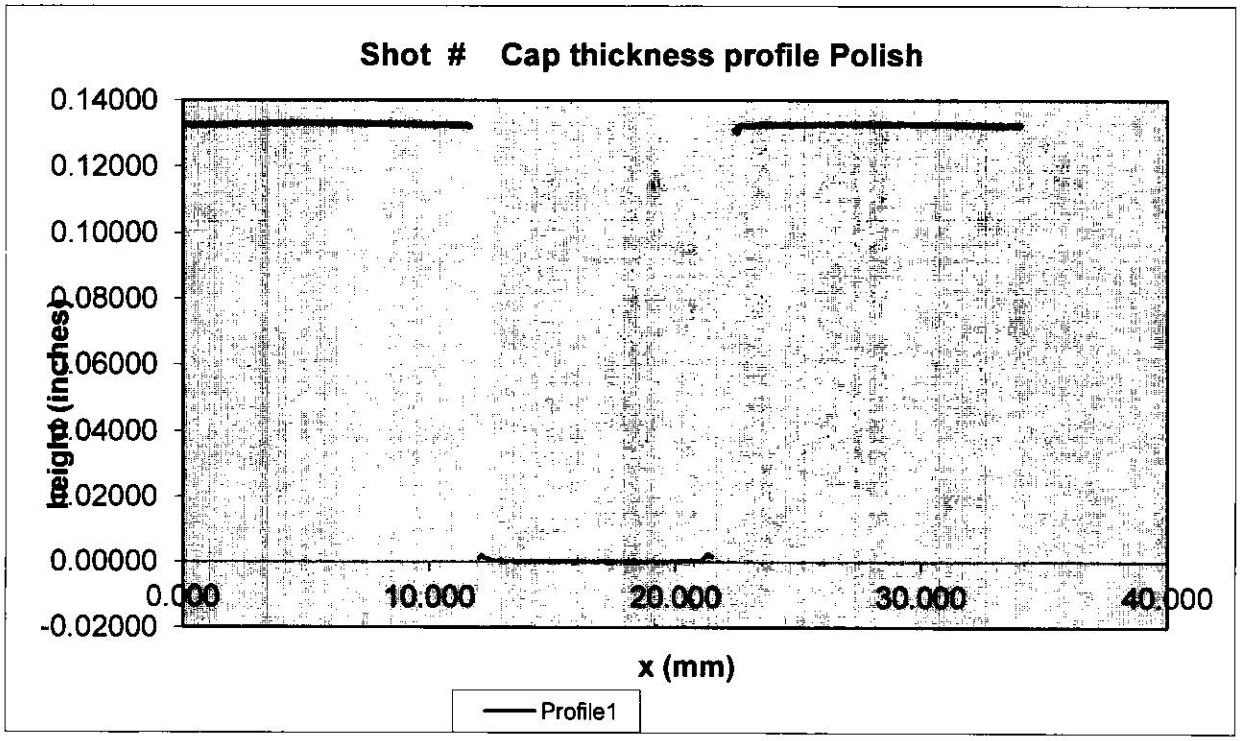
Average thickness reading = 0.00018

Note: Measurement from reference zero point from the base is = **-0.1729** Inches
-4.3904 mm

Average thickness of the driver Plate = -0.0404 Inches
-1.0250 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment

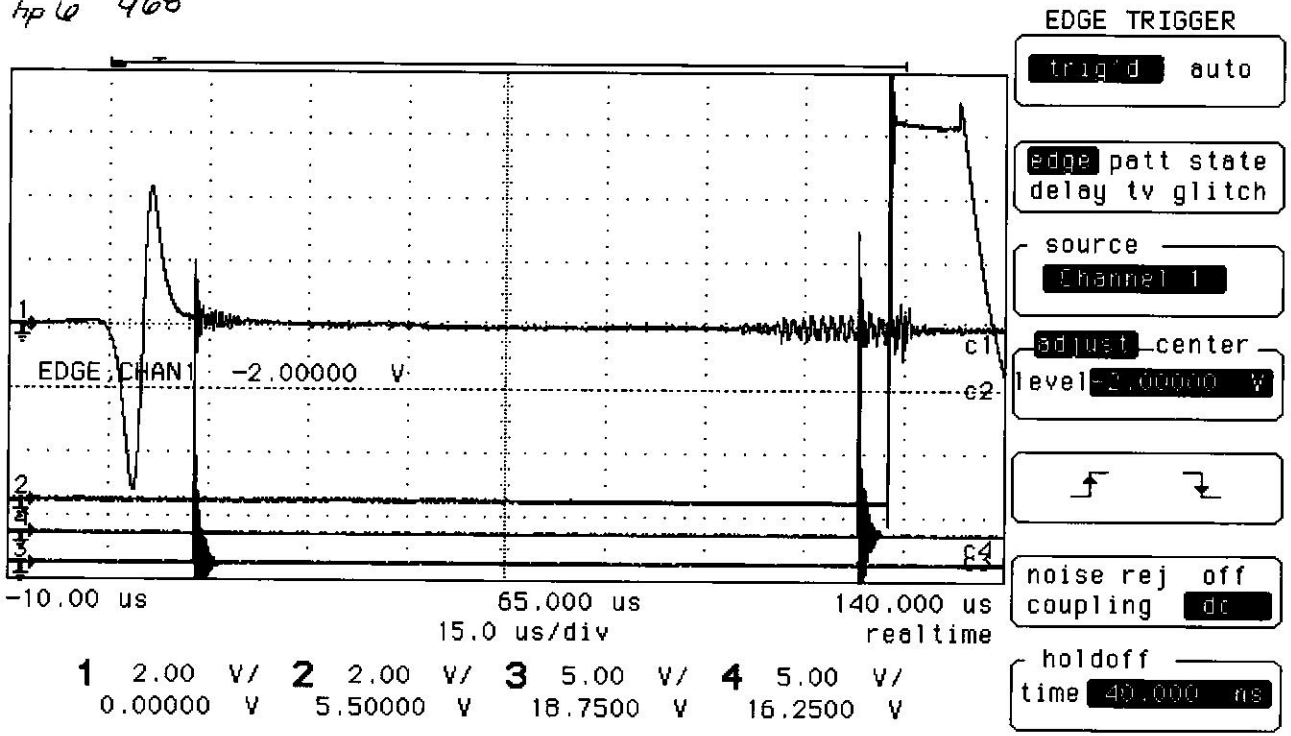
# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s	# reading	dist(mm)
1	0.000	17.000	0.1327	225	22.400	-5.400	0.1307	118	11.700
2	0.100	16.900	0.1325	226	22.500	-5.500	0.1302	119	11.800
3	0.200	16.800	0.1325	227	22.600	-5.600	0.1321	120	11.900
4	0.300	16.700	0.1325	228	22.700	-5.700	0.1322	121	12.000
5	0.400	16.600	0.1325	229	22.800	-5.800	0.1321	122	12.100
6	0.500	16.500	0.1324	230	22.900	-5.900	0.1321	123	12.200
7	0.600	16.400	0.1324	231	23.000	-6.000	0.1320	124	12.300
8	0.700	16.300	0.1324	232	23.100	-6.100	0.1320	125	12.400
9	0.800	16.200	0.1324	233	23.200	-6.200	0.1321	126	12.500
10	0.900	16.100	0.1324	234	23.300	-6.300	0.1322	127	12.600
11	1.000	16.000	0.1324	235	23.400	-6.400	0.1322	128	12.700
12	1.100	15.900	0.1324	236	23.500	-6.500	0.1322	129	12.800
13	1.200	15.800	0.1324	237	23.600	-6.600	0.1323	130	12.900
14	1.300	15.700	0.1324	238	23.700	-6.700	0.1323	131	13.000
15	1.400	15.600	0.1324	239	23.800	-6.800	0.1323	132	13.100
16	1.500	15.500	0.1324	240	23.900	-6.900	0.1323	133	13.200
17	1.600	15.400	0.1324	241	24.000	-7.000	0.1323	134	13.300
18	1.700	15.300	0.1325	242	24.100	-7.100	0.1323	135	13.400
19	1.800	15.200	0.1325	243	24.200	-7.200	0.1323	136	13.500
20	1.900	15.100	0.1325	244	24.300	-7.300	0.1323	137	13.600
21	2.000	15.000	0.1326	245	24.400	-7.400	0.1323	138	13.700
22	2.100	14.900	0.1325	246	24.500	-7.500	0.1323	139	13.800
23	2.200	14.800	0.1326	247	24.600	-7.600	0.1324	140	13.900
24	2.300	14.700	0.1326	248	24.700	-7.700	0.1323	141	14.000
25	2.400	14.600	0.1326	249	24.800	-7.800	0.1323	142	14.100
26	2.500	14.500	0.1326	250	24.900	-7.900	0.1323	143	14.200
27	2.600	14.400	0.1326	251	25.000	-8.000	0.1324	144	14.300
28	2.700	14.300	0.1326	252	25.100	-8.100	0.1323	145	14.400
29	2.800	14.200	0.1327	253	25.200	-8.200	0.1323	146	14.500
30	2.900	14.100	0.1327	254	25.300	-8.300	0.1324	147	14.600
31	3.000	14.000	0.1327	255	25.400	-8.400	0.1324	148	14.700
32	3.100	13.900	0.1327	256	25.500	-8.500	0.1324	149	14.800
33	3.200	13.800	0.1327	257	25.600	-8.600	0.1324	150	14.900
34	3.300	13.700	0.1328	258	25.700	-8.700	0.1324	151	15.000
35	3.400	13.600	0.1328	259	25.800	-8.800	0.1324	152	15.100
36	3.500	13.500	0.1328	260	25.900	-8.900	0.1324	153	15.200
37	3.600	13.400	0.1328	261	26.000	-9.000	0.1324	154	15.300
38	3.700	13.300	0.1328	262	26.100	-9.100	0.1324	155	15.400
39	3.800	13.200	0.1328	263	26.200	-9.200	0.1325	156	15.500
40	3.900	13.100	0.1328	264	26.300	-9.300	0.1325	157	15.600
41	4.000	13.000	0.1329	265	26.400	-9.400	0.1325	158	15.700
42	4.100	12.900	0.1329	266	26.500	-9.500	0.1325	159	15.800
43	4.200	12.800	0.1329	267	26.600	-9.600	0.1325	160	15.900
44	4.300	12.700	0.1329	268	26.700	-9.700	0.1325	161	16.000
45	4.400	12.600	0.1329	269	26.800	-9.800	0.1325	162	16.100
46	4.500	12.500	0.1329	270	26.900	-9.900	0.1325	163	16.200
47	4.600	12.400	0.1329	271	27.000	-10.000	0.1325	164	16.300
48	4.700	12.300	0.1330	272	27.100	-10.100	0.1326	165	16.400
49	4.800	12.200	0.1329	273	27.200	-10.200	0.1326	166	16.500
50	4.900	12.100	0.1329	274	27.300	-10.300	0.1326	167	16.600
51	5.000	12.000	0.1330	275	27.400	-10.400	0.1326	168	16.700
52	5.100	11.900	0.1329	276	27.500	-10.500	0.1326	169	16.800
53	5.200	11.800	0.1329	277	27.600	-10.600	0.1326	170	16.900
54	5.300	11.700	0.1330	278	27.700	-10.700	0.1327	171	17.000
55	5.400	11.600	0.1329	279	27.800	-10.800	0.1326	172	17.100
56	5.500	11.500	0.1329	280	27.900	-10.900	0.1327	173	17.200
57	5.600	11.400	0.1329	281	28.000	-11.000	0.1327	174	17.300
58	5.700	11.300	0.1329	282	28.100	-11.100	0.1327	175	17.400

59	5.800	11.200	0.1330	283	28.200	-11.200	0.1327	176	17.500
60	5.900	11.100	0.1329	284	28.300	-11.300	0.1327	177	17.600
61	6.000	11.000	0.1329	285	28.400	-11.400	0.1327	178	17.700
62	6.100	10.900	0.1329	286	28.500	-11.500	0.1327	179	17.800
63	6.200	10.800	0.1329	287	28.600	-11.600	0.1327	180	17.900
64	6.300	10.700	0.1329	288	28.700	-11.700	0.1327	181	18.000
65	6.400	10.600	0.1329	289	28.800	-11.800	0.1327	182	18.100
66	6.500	10.500	0.1329	290	28.900	-11.900	0.1327	183	18.200
67	6.600	10.400	0.1329	291	29.000	-12.000	0.1327	184	18.300
68	6.700	10.300	0.1329	292	29.100	-12.100	0.1327	185	18.400
69	6.800	10.200	0.1329	293	29.200	-12.200	0.1327	186	18.500
70	6.900	10.100	0.1328	294	29.300	-12.300	0.1327	187	18.600
71	7.000	10.000	0.1329	295	29.400	-12.400	0.1327	188	18.700
72	7.100	9.900	0.1328	296	29.500	-12.500	0.1327	189	18.800
73	7.200	9.800	0.1328	297	29.600	-12.600	0.1327	190	18.900
74	7.300	9.700	0.1328	298	29.700	-12.700	0.1327	191	19.000
75	7.400	9.600	0.1328	299	29.800	-12.800	0.1327	192	19.100
76	7.500	9.500	0.1328	300	29.900	-12.900	0.1326	193	19.200
77	7.600	9.400	0.1328	301	30.000	-13.000	0.1326	194	19.300
78	7.700	9.300	0.1328	302	30.100	-13.100	0.1326	195	19.400
79	7.800	9.200	0.1327	303	30.200	-13.200	0.1326	196	19.500
80	7.900	9.100	0.1327	304	30.300	-13.300	0.1326	197	19.600
81	8.000	9.000	0.1327	305	30.400	-13.400	0.1326	198	19.700
82	8.100	8.900	0.1327	306	30.500	-13.500	0.1326	199	19.800
83	8.200	8.800	0.1327	307	30.600	-13.600	0.1326	200	19.900
84	8.300	8.700	0.1327	308	30.700	-13.700	0.1325	201	20.000
85	8.400	8.600	0.1327	309	30.800	-13.800	0.1325	202	20.100
86	8.500	8.500	0.1327	310	30.900	-13.900	0.1325	203	20.200
87	8.600	8.400	0.1327	311	31.000	-14.000	0.1324	204	20.300
88	8.700	8.300	0.1327	312	31.100	-14.100	0.1324	205	20.400
89	8.800	8.200	0.1327	313	31.200	-14.200	0.1324	206	20.500
90	8.900	8.100	0.1327	314	31.300	-14.300	0.1324	207	20.600
91	9.000	8.000	0.1327	315	31.400	-14.400	0.1324	208	20.700
92	9.100	7.900	0.1326	316	31.500	-14.500	0.1323	209	20.800
93	9.200	7.800	0.1326	317	31.600	-14.600	0.1323	210	20.900
94	9.300	7.700	0.1326	318	31.700	-14.700	0.1323	211	21.000
95	9.400	7.600	0.1326	319	31.800	-14.800	0.1323	212	21.100
96	9.500	7.500	0.1325	320	31.900	-14.900	0.1323	213	21.200
97	9.600	7.400	0.1325	321	32.000	-15.000	0.1323	214	21.300
98	9.700	7.300	0.1325	322	32.100	-15.100	0.1322	215	21.400
99	9.800	7.200	0.1325	323	32.200	-15.200	0.1322	216	21.500
100	9.900	7.100	0.1325	324	32.300	-15.300	0.1322	217	21.600
101	10.000	7.000	0.1325	325	32.400	-15.400	0.1322	218	21.700
102	10.100	6.900	0.1325	326	32.500	-15.500	0.1322	219	21.800
103	10.200	6.800	0.1324	327	32.600	-15.600	0.1322	220	21.900
104	10.300	6.700	0.1324	328	32.700	-15.700	0.1321	221	22.000
105	10.400	6.600	0.1324	329	32.800	-15.800	0.1321	222	22.100
106	10.500	6.500	0.1325	330	32.900	-15.900	0.1321	223	22.200
107	10.600	6.400	0.1324	331	33.000	-16.000	0.1321	224	22.300
108	10.700	6.300	0.1324	332	33.100	-16.100	0.1321		
109	10.800	6.200	0.1324	333	33.200	-16.200	0.1321		
110	10.900	6.100	0.1323	334	33.300	-16.300	0.1321		
111	11.000	6.000	0.1323	335	33.400	-16.400	0.1321		
112	11.100	5.900	0.1323	336	33.500	-16.500	0.1321		
113	11.200	5.800	0.1323	337	33.600	-16.600	0.1322		
114	11.300	5.700	0.1323	338	33.700	-16.700	0.1321		
115	11.400	5.600	0.1323	339	33.800	-16.800	0.1322		
116	11.500	5.500	0.1323	340	33.900	-16.900	0.1322		
117	11.600	5.400	0.1319	341	34.000	-17.000	0.1323		

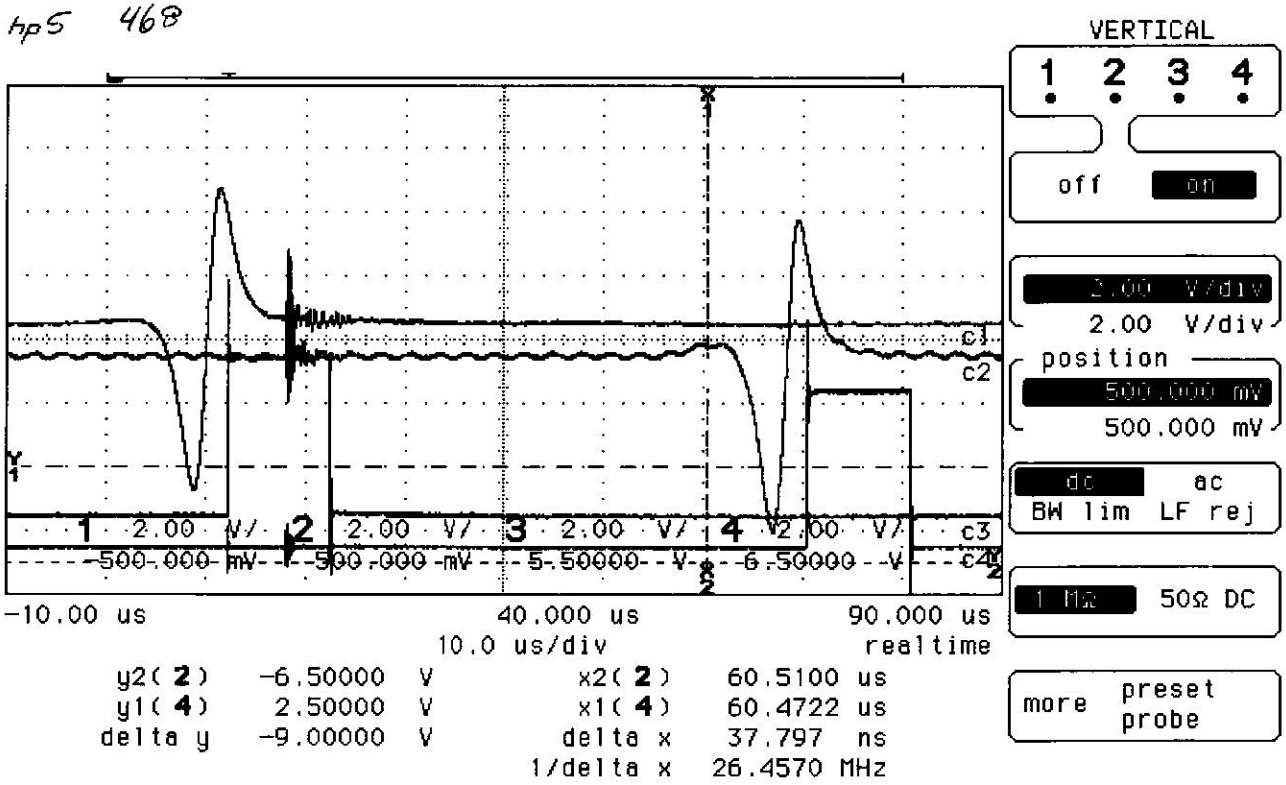
absdist(mm	1st	2nd	3 rd
5.300	Run	Run	Run
5.200	Reading	Reading	Reading
5.100	Inches	Inches	Inches
5.000			
4.900			
4.800			
4.700	0.00090		
4.600	0.00205		
4.500	0.00115		
4.400	0.00110		
4.300	0.00055		
4.200	0.00045		
4.100	0.00020		
4.000	0.00020		
3.900	0.00015		
3.800	0.00015		
3.700	0.00020		
3.600	0.00010		
3.500	0.00015		
3.400	0.00015		
3.300	0.00015		
3.200	0.00010		
3.100	0.00010		
3.000	0.00010		
2.900	0.00010		
2.800	0.00010		
2.700	0.00005		
2.600	0.00010		
2.500	0.00005		
2.400	0.00010		
2.300	0.00005		
2.200	0.00010		
2.100	0.00005		
2.000	0.00005		
1.900	0.00005		
1.800	0.00005		
1.700	0.00000		
1.600	0.00005		
1.500	0.00005		
1.400	0.00005		
1.300	0.00005		
1.200	0.00000		
1.100	0.00005		
1.000	0.00005		
0.900	0.00005		
0.800	0.00005		
0.700	0.00005		
0.600	0.00005		
0.500	0.00000		
0.400	0.00000		
0.300	0.00000		
0.200	0.00000		
0.100	-0.00005		
0.000	0.00000		
-0.100	0.00000		
-0.200	0.00000		
-0.300	-0.00005		
-0.400	-0.00005		

-0.500	0.00000		
-0.600	0.00000		
-0.700	0.00000		
-0.800	-0.00005		
-0.900	-0.00005		
-1.000	-0.00005		
-1.100	-0.00005		
-1.200	0.00000		
-1.300	0.00000		
-1.400	-0.00005		
-1.500	-0.00005		
-1.600	-0.00005		
-1.700	-0.00005		
-1.800	-0.00005		
-1.900	-0.00005		
-2.000	-0.00005		
-2.100	0.00000		
-2.200	-0.00005		
-2.300	0.00000		
-2.400	0.00000		
-2.500	-0.00005		
-2.600	-0.00005		
-2.700	0.00000		
-2.800	-0.00005		
-2.900	-0.00005		
-3.000	-0.00005		
-3.100	0.00005		
-3.200	0.00005		
-3.300	0.00000		
-3.400	0.00005		
-3.500	0.00005		
-3.600	0.00010		
-3.700	0.00015		
-3.800	0.00010		
-3.900	0.00010		
-4.000	0.00015		
-4.100	0.00015		
-4.200	0.00020		
-4.300	0.00025		
-4.400	0.00085		
-4.500	0.00150		
-4.600	0.00240		
-4.700	0.00175		
-4.800	0.00150		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			

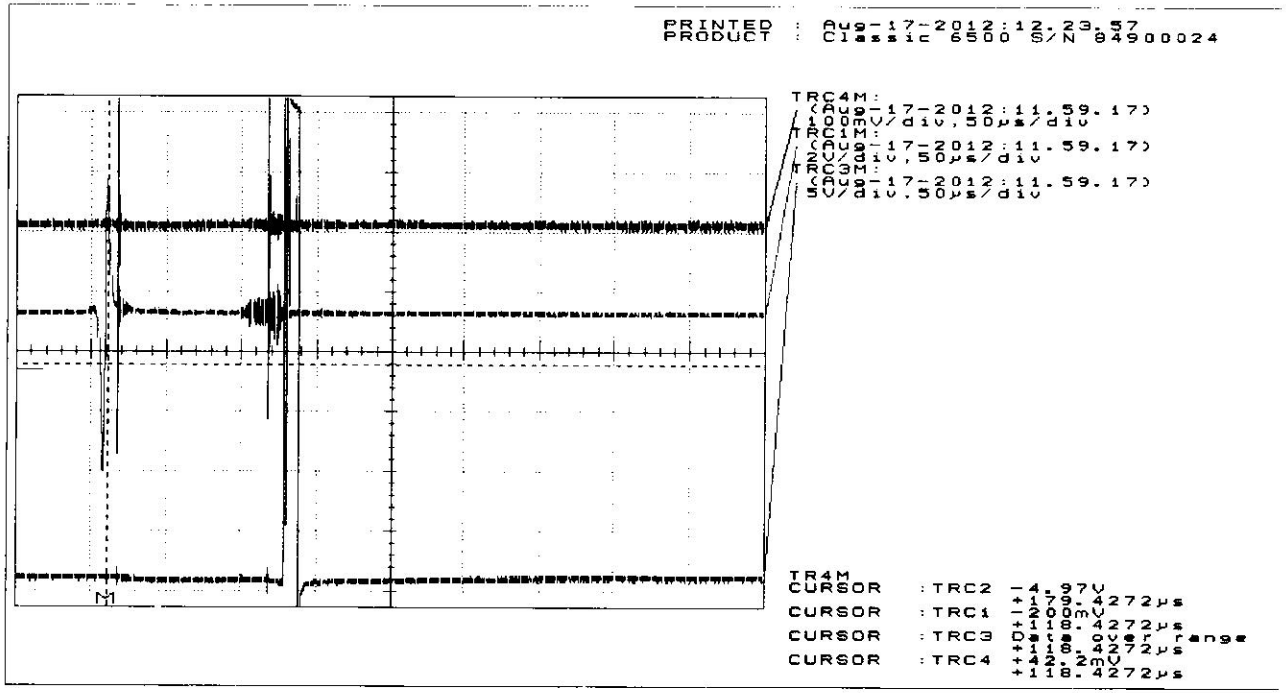
hp 6 468


EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 1
adjust center
level -2.00000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
EDGE,CHAN1 -2.00000 V
c1
c2
c4
-10.00 us
65.000 us
140.000 us
15.0 us/div
realtime
1 2.00 V/ 0.00000 V
2 2.00 V/ 5.50000 V
3 5.00 V/ 18.7500 V
4 5.00 V/ 16.2500 V

hp5 468

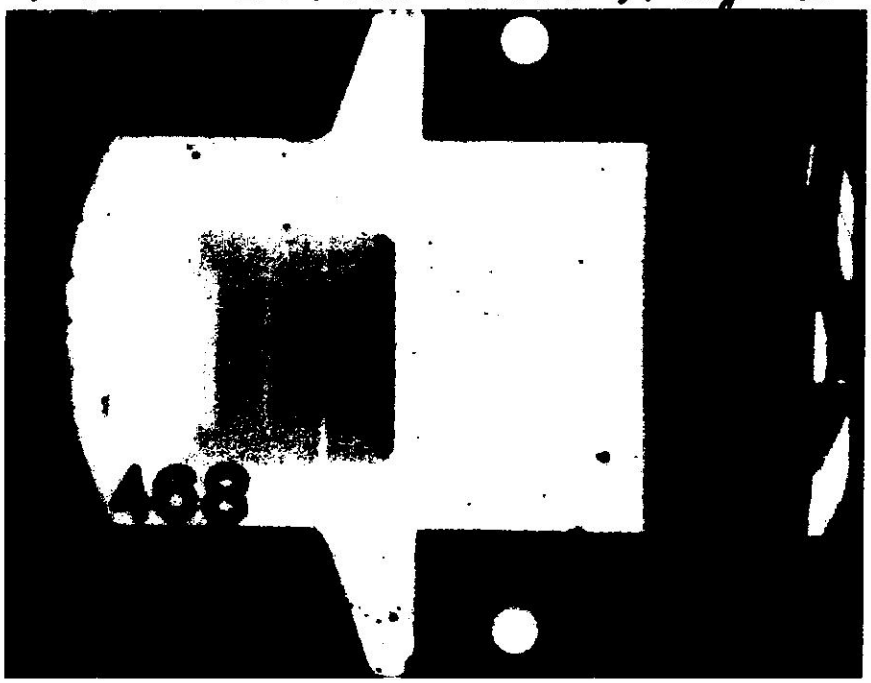

VERTICAL
1 2 3 4
off on
2.00 V/div
2.00 V/div
position
500.000 mV
500.000 mV
dc ac
BW lim LF rej
1 MΩ 50Ω DC
more preset probe
c1
c2
c3
c4
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/
-500.000 mV -500.000 mV -5.50000 V -6.50000 V
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(2) -6.50000 V
y1(4) 2.50000 V
delta y -9.00000 V
x2(2) 60.5100 us
x1(4) 60.4722 us
delta x 37.797 ns
1/delta x 26.4570 MHz

GS7 #468

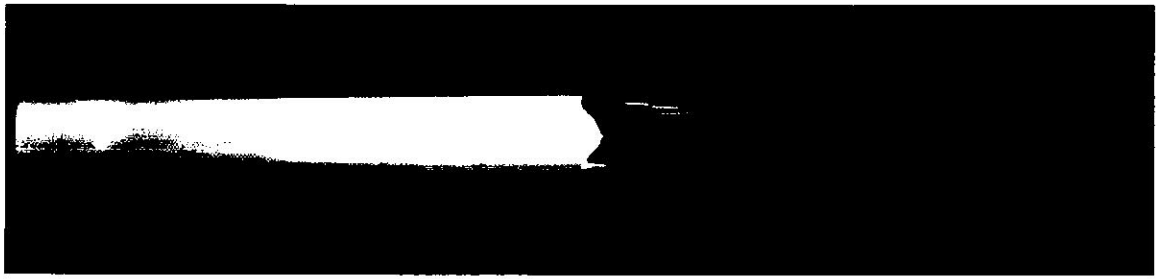

PRINTED : Aug-17-2012:12.23.57
PRODUCT : Classic 6500 S/N 04900024
TRC4M:
(Aug-17-2012:11.59.17)
100mV/div,50µs/div
TRC1M:
(Aug-17-2012:11.59.17)
2V/div,50µs/div
TRC3M:
(Aug-17-2012:11.59.17)
5V/div,50µs/div
M1
TR4M
CURSOR :TRC2 -4.97V
+118.4272µs
CURSOR :TRC1 -200mV
+118.4272µs
CURSOR :TRC3 Data over range
+118.4272µs
CURSOR :TRC4 +42.2mV
+118.4272µs

8/17/2012 LGG shot #468 X-ray #1

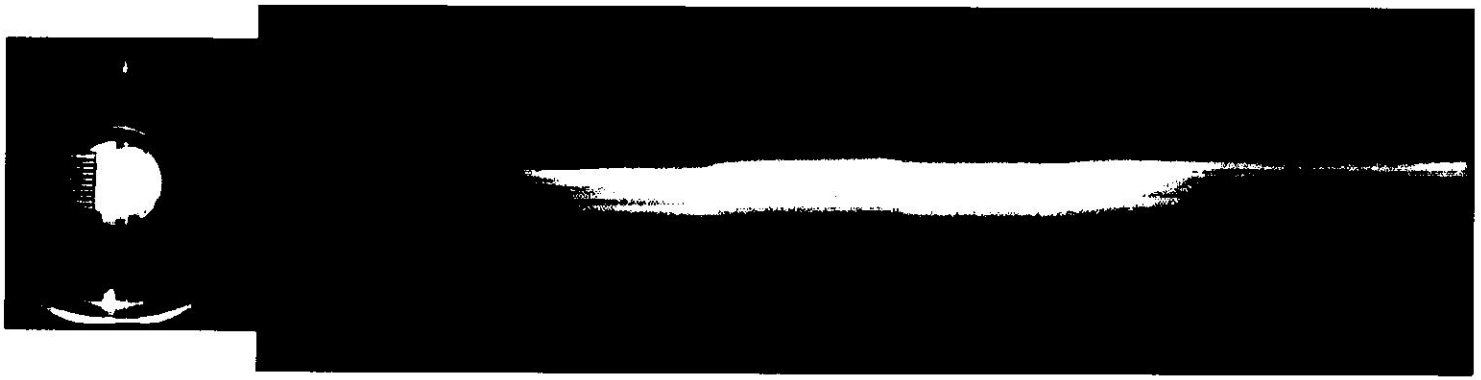
8/17/2012 LGG shot #468 X-ray #2



468 shot



468 SIM



LIGHT GAS GUN DATA SHEET

Shot No. #469 Date 8/22/12

Target:

Sample Material Ac-Hd Crystallographic orientation —

Source Location UMICH, R. Lange Thickness: 1 — in.

Type of Measurement Reshocked EOS 1400°C 2. — in.

Bulk Density — gm/cc Crystal Density — gm/cc

±2 std. devs. — gm/cc ±2 std. devs. — gm/cc

Total Shorting Pin Height — in. (shim to driver) Driver Plate Thickness Material Mo 1.03 mm

Projectile: Mo #2

Weight 29.1648 gms. Length 0.9100 in. Skirt Diameter 1.1129 in.

Flyer Plate Material Mo Leading Edge Dia. 1.1007 in.

Thickness 0.0606 in. Major Dia. 0.984 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. Pressure 130 lbs

Temp 21°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.113 in.

Diameter: Front 3.494 in. Back 3.496 in.

Pump Tube:

Pre-Fill Pressure _____ in. Hg Fill Pressure _____ psig.

Powder Charge:

Main Charge 538 gms. Type IMR 4350 Total Charge 550 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 4.7 km/sec Piston 0.577 km/sec

Notes: Heat to 1414°C for pyrex window correction

L.G.G.

Camera Streak Duration: 1512 nsec Timing calibration frequency: 147.8950 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 3.1 µsec Flash X-ray #2 78.3 µsec

Static Streak Photo ~ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0351 in. min. 0.0936 in. min.

0.0560 in. max. 0.0938 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 103/107 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	521 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1058 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	43.006 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	74.856 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	82.485 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.633 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	74.874 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	42.940 µsec
UDC Velocity:			4741.92 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	129.60 ns
HP5, 2:	Velocity magnet 2	43.0976 µsec
HP5, 3:	TTL Start	2.15820 µsec
HP5, 4:	TTL Stop	45.0856 µsec
HP6, 1:	Velocity Magnet 1	108 ns
HP6,2:	Xenon Lamp Trigger	81.6078 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	5.8856 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	80.7602 µsec
GS7, 1:	Velocity Magnet 1	-834.502 ns ~~µsec~~
GS7,3:	Camera Trigger (UDC HV 1)	87.0075 µsec
GS7, 4:	Camera Monitor Out	87.2305 µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	43.300 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	75.724 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	83.121 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	7.401 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	75.717 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	43.260 µsec
UDC Velocity:			4706.73 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	400 ns
HP5, 2:	Velocity magnet 2	43.600 µsec
HP5, 3:	TTL Start	2.400 µsec
HP5, 4:	TTL Stop	45.600 µsec
HP6, 1:	Velocity Magnet 1	416 ns
HP6,2:	Xenon Lamp Trigger	82.526 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	6.1792 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	81.8926 µsec
GS7, 1:	Velocity Magnet 1	−457 ns ~~µsec~~
GS7, 2:	Camera Cal. Sig.	88.664 µsec
GS7,3:	Camera Trigger (UDC HV 1)	87.989 µsec
GS7, 4:	Camera Monitor Out	88.205 µsec

Shot 469 Nominal Timeline Preshot

	V	4700				meters	mag SIM time	43320 ns			rho0	Co	s			
cable time		90	150		M1-M2 distance	0.203606				Cold Mo	10206	5033	1.28946405			
intervalometer intrinsic delay		[redacted]			M2-target distance	0.217449				Hot Mo	9937	4918.5831	1.28837124	1407		
UDC extra count lag		[redacted]			M2-target fudge	[redacted]				Liquid An-Hd	[redacted]					
pulse translator delay		150			M1-fid1 distance	0.03										
X-ray 1 program delay		[redacted]	3149	X-ray 1 actual delay	M1-fid2 distance	0.383145										
X-ray 2 program delay		[redacted]	78286	X-ray 2 actual delay	Flyer thickness	0.00153924										
X-ray 1 pulser delay		600												up	P	Us
X-ray 2 pulser delay		[redacted]			Us(Mo)	7991.63874				driver	357.7250824	-223949297	5.32134E+11	2385.22527	189.417689	7991.63874
Camera intrinsic delay		107			driver thickness	0.00103632				sample	8420.397546	-178747861	5.2451E+11	3517.07119	81.3724021	8296.51567
Lamp trigger to peak brightness		7127			cap thickness	0.00077038				cap	-8420.39755	-118249344	2.71157E+11	2006.42834	149.606017	7503.60766
HV#3 delay to lamp		-6370			estimated sample+cover time	222.531621										
Streak duration		1514														
Desired dead streak before driver		500														

t (ns)	flyer x (m)	shock front (m)	event								
0	0.00076962		M1 zero-crossing				X-ray velocity	4700			
150	0.00147462		HP5-1, GS7-1, HP6-1, Intervalometer start					On film			
2230	0.01125062		HP5-3, UDC start, signal to pulse translator			X-ray 1 flyer vs. fid (mm)	-0.00108	-0.0012558			
2380	0.01195562		pulse translator out								
5529	0.02675592		X-ray 1 delay amp out to counters 4, 5								
6219	0.02999892		X-ray 1 fires								
6309	0.03042192		X-ray 1 pulse monitor at counter 4b								
43320	0.20437562		M2 zero-crossing	Counter 3:	43320						
43470	0.20508062		HP5-2, Intervalometer stop			HP5 2-1	43320				
45550	0.21485662		HP5-4, UDC stop	UDC upcount:	43320	HP5 4-3	43320				
80666	0.37989982		X-ray 2 delay amp, stop counter 4, start counter 6	Counter 4:	75137						
81381	0.38326032		X-ray 2 fires	X-ray 2 flyer vs. fid (mm)			0.11532	0.13409302			
81471	0.38368332		X-ray 2 pulse monitor at counter 4b	Counter 4b:	75162						
88855	0.41838857		UDC out, GS7-3, stop counters 5 and 6	Counter 5:	83326	GS7 3-1	88705				
88945	0.41881157		Trigger at camera	Counter 6:	8189	GS7 4-1	88992				
89052	0.41931447		Begin Streak								
89142	0.41973747		Camera Monitor on GS7-4			HP6-1					
89422	0.421055	0	IMPACT								
89552		0.00103632	Driver arrival on streak								
89775		0.002814712	Sample cutoff on streak								
90566		0.009139842	End Streak								

Driver cutoff on streak	500
Sample cutoff on sreak	723

		scopes			
trig	92	GS7-1	0	10V pp	rising
sim only		GS7-2	89355	10 V _-_	ttl
		GS7-3	88705	40 V _-_	
		GS7-4	88992	(-)1.75 V	down going
trig		HP5-1	0	10V pp	rising
	47	HP5-2	43320	10V pp	rising
		HP5-3	2080	5 V _-_	
		HP5-4	45400	5 V _-_	
trig		HP6-1	0	10V pp	rising
HV#1-14.3us		HP6-2	82485	10 V _-_	
		HP6-3	6159	25 V /\	
	56	HP6-4	81321	25 V /\	

2 2 5 100mV 2 2 2 2 2 5 5

Shot 469 Nominal Timeline Preshot

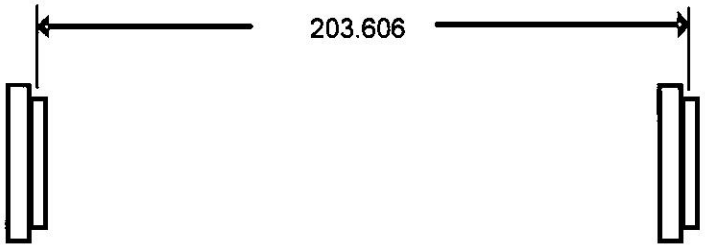
V	4500				meters	mag SIM time	45246	ns			rho0	Co	s						
cable time	90	150		M1-M2 distance	0.203606					Cold Mo	10206	5033	1.28946405						
intervalometer intrinsic delay	[redacted]			M2-target distance	0.217449					Hot Mo	9937	4918.5831	1.28837124	1407					
UDC extra count lag	[redacted]			M2-target fudge	[redacted]					Liquid An-Hd	[redacted]								
pulse translator delay	150			M1-fid1 distance	0.03														
X-ray 1 program delay	[redacted]	3425	X-ray 1 actual delay	M1-fid2 distance	0.383145														
X-ray 2 program delay	[redacted]	81901	X-ray 2 actual delay	Flyer thickness	0.00153924														
X-ray 1 pulser delay	600														up	P	Us		
X-ray 2 pulser delay	[redacted]			Us(Mo)	7861.43205					driver	357.7250824	-218685189	4.97646E+11	2284.16225	178.436586	7861.43205			
Camera intrinsic delay	107			driver thickness	0.00103632					sample	8420.397546	-173572406	4.90465E+11	3379.90016	76.1670864	8080.96511			
Lamp trigger to peak brightness	7127			cap thickness	0.00077038					cap	-8420.39755	-115844930	2.52455E+11	1913.19379	140.370473	7383.48695			
HV#3 delay to lamp	-6370			estimated sample+cover time	227.156231														
Streak duration	1514																		
Desired dead streak before driver	500																		

t (ns)	flyer x (m)	shock front (m)	event								
0	0.00076962		M1 zero-crossing								
150	0.00144462		HP5-1, GS7-1, HP6-1, Intervalometer start			X-ray velocity	4500				
2230	0.01080462		HP5-3, UDC start, signal to pulse translator				On film				
2380	0.01147962		pulse translator out	X-ray 1 flyer vs. fid (mm)	-0.00288	-0.0033488					
5805	0.02689212		X-ray 1 delay amp out to counters 4, 5							scopes	
6495	0.02999712		X-ray 1 fires						triq	GS7-1	0 10V pp rising
6585	0.03040212		X-ray 1 pulse monitor at counter 4b						sim only	GS7-2	93332 10 V _-_ ttl
45246	0.20437562		M2 zero-crossing	Counter 3:	45246					GS7-3	92682 40 V _-_
45396	0.20505062		HP5-2, Intervalometer stop			HP5 2-1	45246			GS7-4	92969 (-)1.75 V down going
47476	0.21441062		HP5-4, UDC stop	UDC upcount:	45246	HP5 4-3	45246		triq	HP5-1	0 10V pp rising
84281	0.38003412		X-ray 2 delay amp, stop counter 4, start counter 6	Counter 4:	78476					HP5-2	45246 10V pp rising
84996	0.38325162		X-ray 2 fires	X-ray 2 flyer vs. fid (mm)	0.10662	0.12397674				HP5-3	2080 5 V _-_
85086	0.38365662		X-ray 2 pulse monitor at counter 4b	Counter 4b:	78501					HP5-4	47326 5 V _-_
92832	0.4185117		UDC out, GS7-3, stop counters 5 and 6	Counter 5:	87027	GS7 3-1	92682		triq	HP6-1	0 10V pp rising
92922	0.4189167		Trigger at camera	Counter 6:	8551	GS7 4-1	92969		HV#1-14.3us	HP6-2	86462 10 V _-_
93029	0.4193982		Begin Streak							HP6-3	6435 25 V /\
93119	0.4198032		Camera Monitor on GS7-4			HP6-1				HP6-4	84936 25 V /\
93397	0.421055	0	IMPACT								
93529		0.00103632	Driver arrival on streak								
93756		0.002822093	Sample cutoff on streak								
94543		0.00900781	End Streak								

Driver cutoff on streak	500
Sample cutoff on sreak	727

MAGNET DISTANCE

Shot No. **469** Expected Velocity: **4.70**



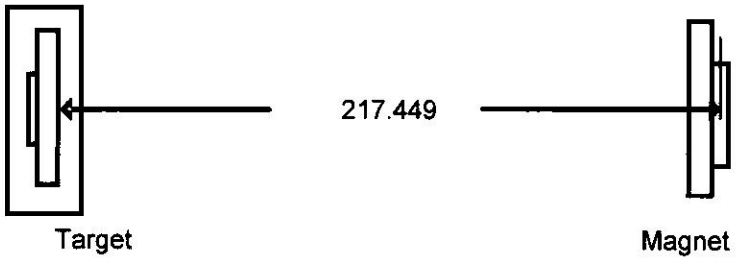
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **43.321 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.436 inch

Second measurement = 8.436 inch

Average measurement = 8.436 inch

Average measurement = 214.274 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

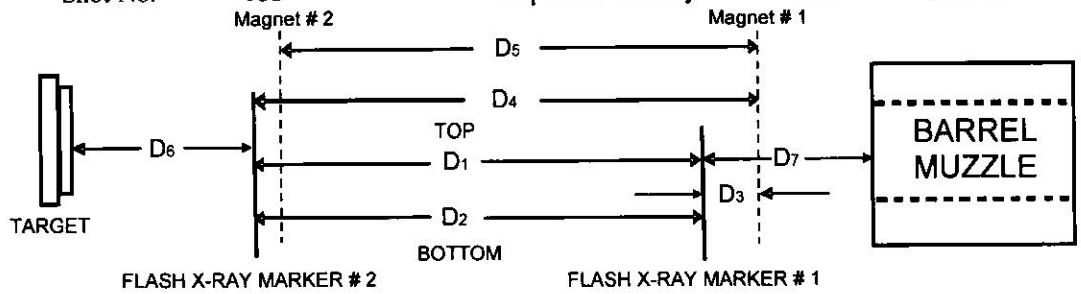
Distance Between Magnet # 2 to Target = 217.449 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **46.266 µsec.**

Fudged Distance between Magnet 2 to Target = 202.954 mm

TARGET MEASUREMENT

Shot No. **469** Expected Velocity: **4.70** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	8.375	99.0
Measure # 2, mm	30.00	383.15	203.66	8.377	99.0
Average, mm	30.00	383.15	203.61	8.376	99.0
Travel time, µsec	**6.38**	**81.52**	**43.32**	**1.78**	**21.06**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **75.15** µsec.

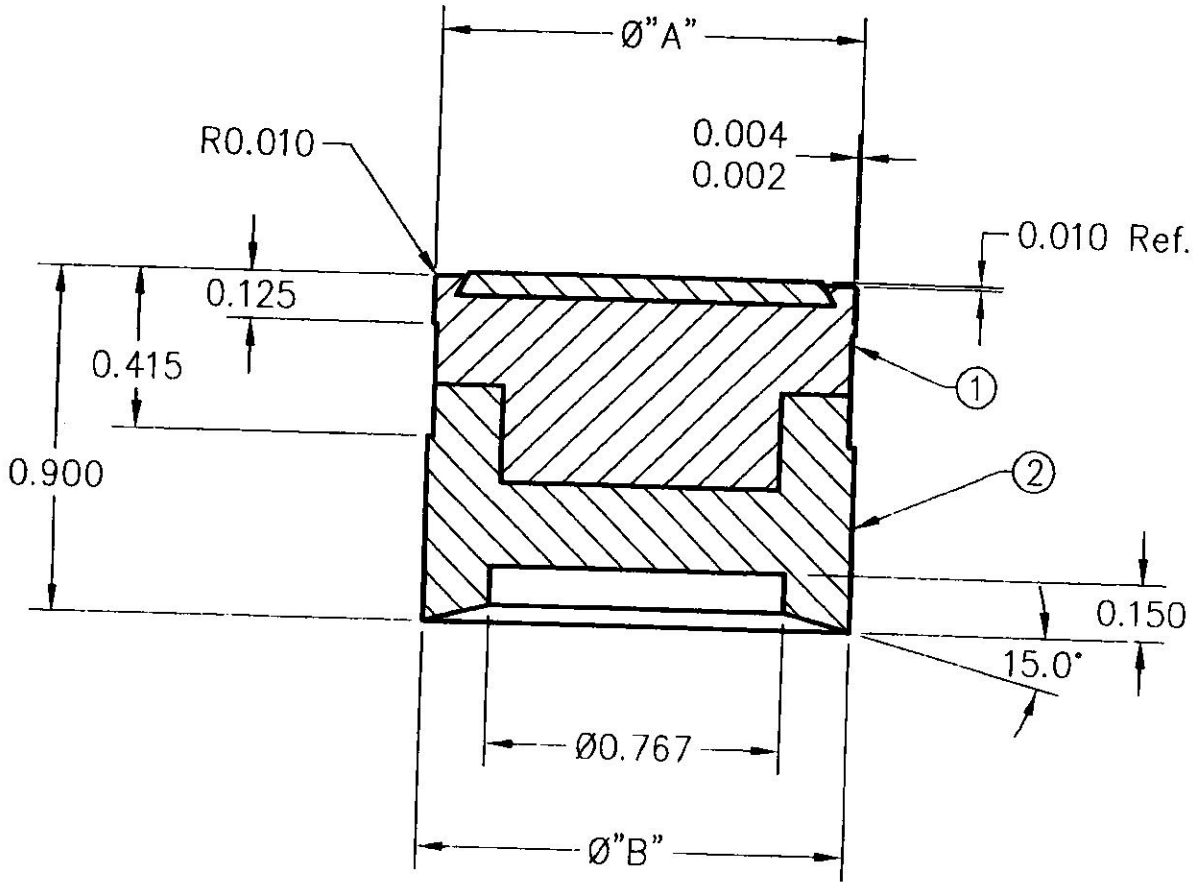
Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **75.12** µsec.

			sheet values
Flash X-Ray # 1 Delay (from Magnet # 1)	**3.28**	µsec.	3.149 ns
Flash X-Ray # 2 Delay (from Magnet # 1)	**78.87**	µsec.	78.286 ns



Mold #2

Built As
1.1007
1.11295

SHOT#		
A	1.1007	+.0000 −.0005
B	1.1125	+.0005 −.0000

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-128	1
1	Sabot & Flyer Plate	LGG-157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN: M. Long — DATE: 11/29/10
ENGINEER — DATE
APPROVED — DATE

MATERIAL: Zelux-M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy. for 28mm launch tube (GM)

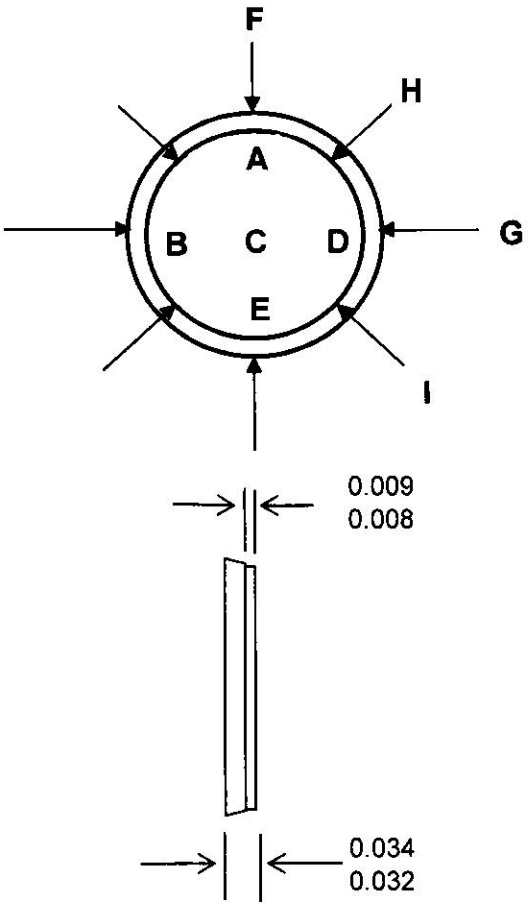
SCALE: 2:1 | SHEET: 2 of 2 | A | DRAWING NUMBER: LGG-158

SHOT No.

FLYER PLATE MATERIAL: **Mo2** 7/5/2012

Measurement done by: Emma

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06070	F	0.98400
A	0.06075	F	0.98350
B	0.06070	G	0.98400
B	0.06075	G	0.98450
C	0.06065	H	0.92700
C	0.06070	H	0.92700
D	0.06055	I	0.92700
D	0.06050	I	0.92700
E	0.06060		
E	0.06065		



Statistic for thickness

N	10
MAX	0.06075
MIN	0.06050
Range	0.00025
MEAN	0.06066
	1.540637 mm
STDEV	8.31665E-05

Statistic for Diameter (F-G)

N	4
MAX	0.98450
MIN	0.98350
Range	0.00100
MEAN	0.9840000 inch
	24.9936000 mm
STDEV	0.000408248

Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927 inch
	23.5458 mm
STDEV	0

	Sample in Air	Crystal Density	
1	7.18771	10.23	
2	7.18768	10.23	
3	7.18765	10.23	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.06066	±	in
FLATNESS:	0.00025	in.	
VOLUME:			cm^3
CRYSTAL DENSITY:	10.2300		$grams/cm^3$
BULK DENSITY:	#DIV/0!		$grams/cm^3$

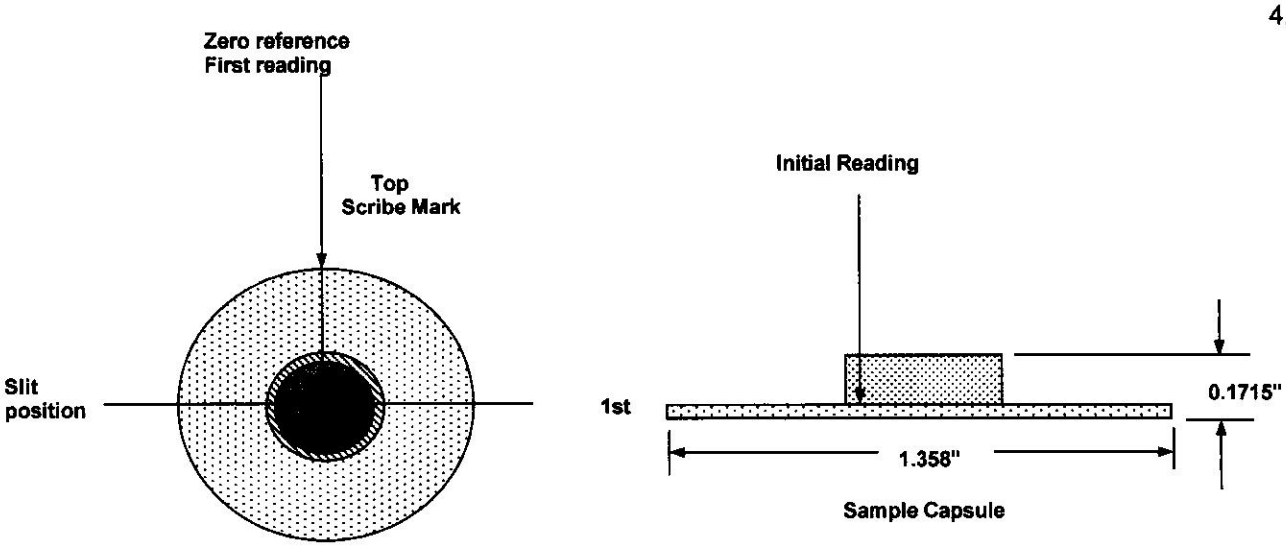
DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED B Emma 7/5/2012

SAMPLE CAPSULE **32**
SAMPLE MATERIAL: **Molybdenum**

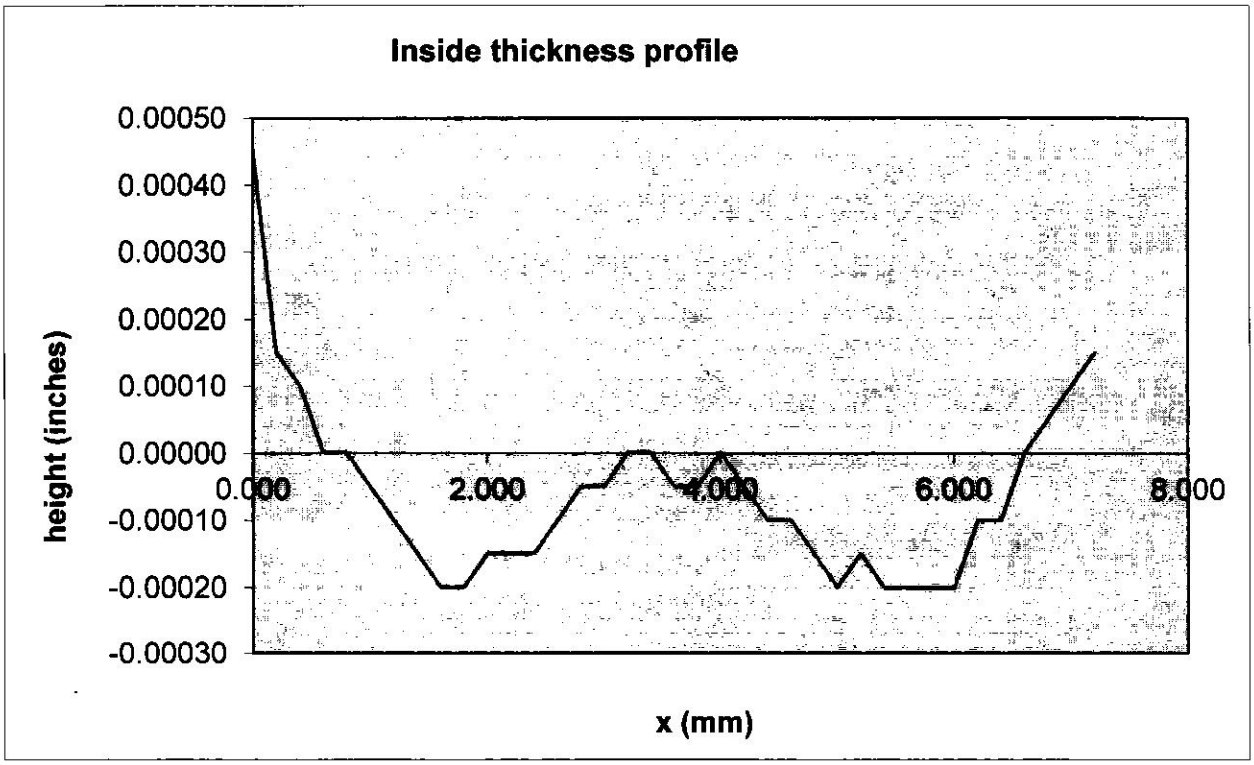
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.683
4.623



Average thickness reading = -0.00006

Note: The thickness of the reference zero point from the base is = **0.04240** Inches
1.07696 mm



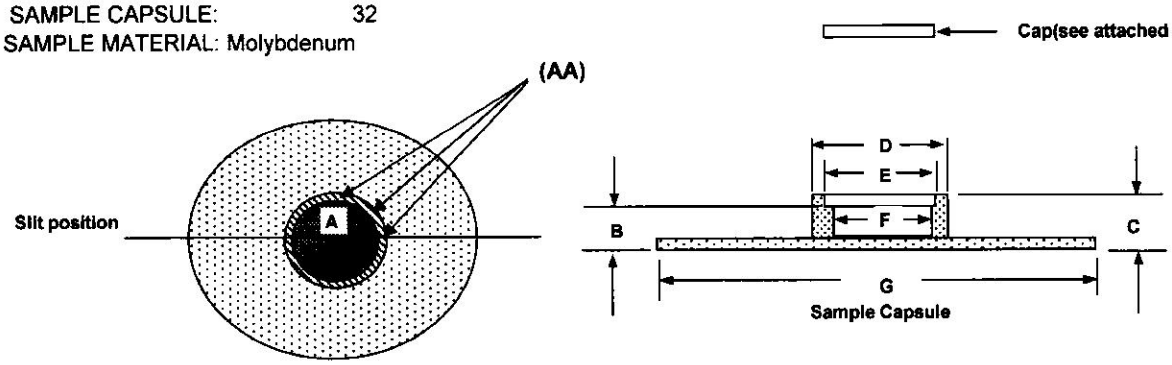
Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00045	3.6	south
2	0.200	0.00015	3.40	
3	0.400	0.00010	3.20	
4	0.600	0.00000	3.00	
5	0.800	0.00000	2.80	
6	1.000	-0.00005	2.60	
7	1.200	-0.00010	2.40	
8	1.400	-0.00015	2.20	
9	1.600	-0.00020	2.00	
10	1.800	-0.00020	1.80	
11	2.000	-0.00015	1.60	
12	2.200	-0.00015	1.40	
13	2.400	-0.00015	1.20	
14	2.600	-0.00010	1.00	
15	2.800	-0.00005	0.80	
16	3.000	-0.00005	0.60	
17	3.200	0.00000	0.40	
18	3.400	0.00000	0.20	
19	3.600	-0.00005	0.00	
20	3.800	-0.00005	-0.20	
21	4.000	0.00000	-0.40	
22	4.200	-0.00005	-0.60	
23	4.400	-0.00010	-0.80	
24	4.600	-0.00010	-1.00	
25	4.800	-0.00015	-1.20	
26	5.000	-0.00020	-1.40	
27	5.200	-0.00015	-1.60	
28	5.400	-0.00020	-1.80	
29	5.600	-0.00020	-2.00	
30	5.800	-0.00020	-2.20	
31	6.000	-0.00020	-2.40	
32	6.200	-0.00010	-2.60	
33	6.400	-0.00010	-2.80	
34	6.600	0.00000	-3.00	
35	6.800	0.00005	-3.20	
36	7.000	0.00010	-3.40	
37	7.200	0.00015	-3.60	north

SHOT No.: 469 prepolish 11/18/2010

SAMPLE CAPSULE: 32

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04150
A	0.04155
A	0.04150
A	0.04150
Avg	0.04151

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3530
E	0.3535
F	0.3140
F	0.3140

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17170
C	0.17230
C	0.17215
C	0.17180
D	0.3960
D	0.3955
G	1.3590
G	1.3590
H	0.10127

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14250
B point 2	0.14265
B point 3	0.14330
B point 4	0.14315
B point 5	0.14305
B point 6	0.14250
B point 7	0.14255
B point 8	0.14255

Statistics

N	8
MAX	0.14330
MIN	0.14250
Range	0.00080
Average	0.14278

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SHOT No. _____469_____

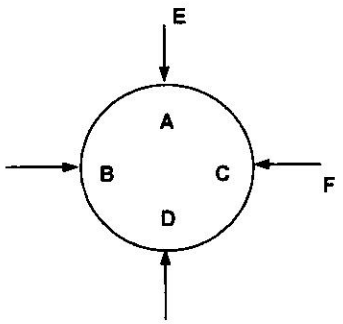
LGG Moly Capsule Cap

11/18/2010

SAMPLE MATERIAL: Mo 32

Post polish

Thickness Measurement	
A	0.03030
A	0.03035
B	0.03035
B	0.03025
C	0.03035
C	0.03035
D	0.03035
D	0.03035



Diameter Measurement	
E	0.35450
E	0.35450
F	0.35400
F	0.35450
AVE	0.35438
Radius	0.1772

Statistic for thickness	
N	8
MAX	0.03035
MIN	0.0303
Range	1E-04
MEAN	0.03033
STDEV	3.72012E-05

Statistic for perimeter	
N	4
MAX	0.35450
MIN	0.354
Range	0.0005
MEAN	0.354375
STDEV	0.00025

post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03033125	±	mm	
	FLATNESS:		1E-04			
	VOLUME:		0.0490		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.1433		$grams/cm^3$	

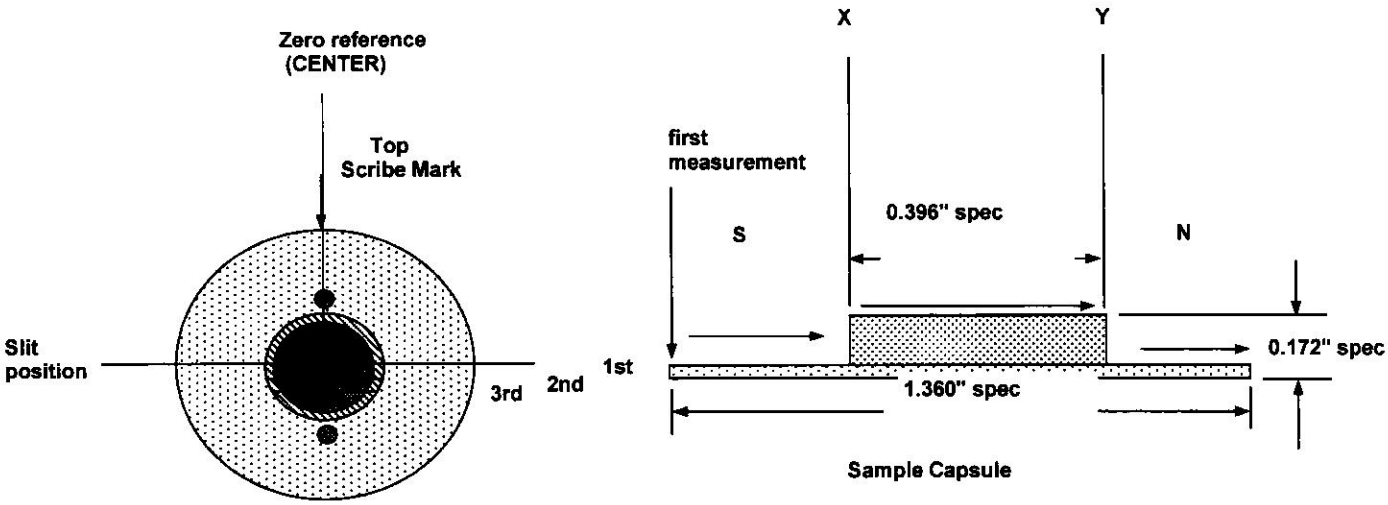
SHOT No. __469_____ tip used: .7mm long/ flat tip

SAMPLE CAPSULE: 32

SAMPLE MATERIAL: An-Hd 3.935

direction of measurement

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

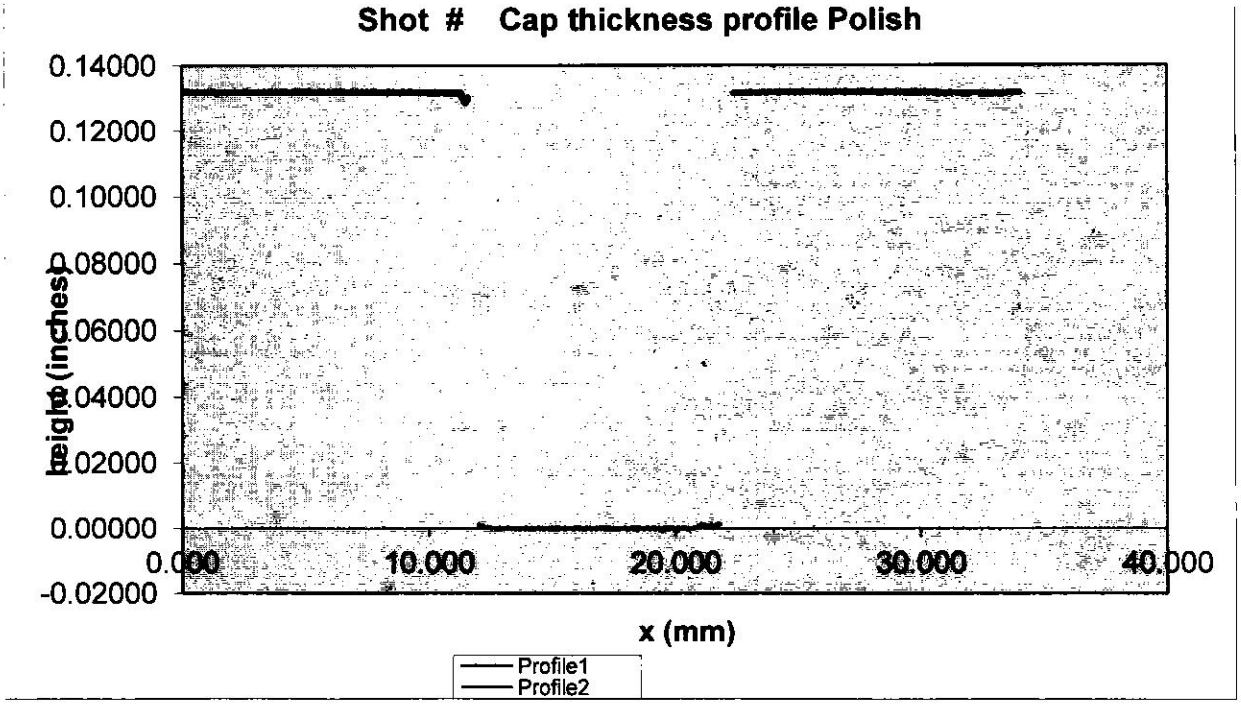
Average thickness reading = -0.00005

Note: Measurement from reference zero point from the base is = **-0.1724** Inches
-4.3790 mm

Average thickness of the driver Plate = -0.0408 Inches
-1.0372 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1
Profile2

1. First Run Horizontal (X) thru the center with 0.100 MM increment

inches

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s	# reading	dist(mm)
1	0.000	17.000	0.1319	225	22.400	-5.400	0.1312	118	11.700
2	0.100	16.900	0.1318	226	22.500	-5.500	0.1313	119	11.800
3	0.200	16.800	0.1318	227	22.600	-5.600	0.1314	120	11.900
4	0.300	16.700	0.1317	228	22.700	-5.700	0.1314	121	12.000
5	0.400	16.600	0.1317	229	22.800	-5.800	0.1314	122	12.100
6	0.500	16.500	0.1317	230	22.900	-5.900	0.1314	123	12.200
7	0.600	16.400	0.1317	231	23.000	-6.000	0.1314	124	12.300
8	0.700	16.300	0.1317	232	23.100	-6.100	0.1314	125	12.400
9	0.800	16.200	0.1317	233	23.200	-6.200	0.1314	126	12.500
10	0.900	16.100	0.1317	234	23.300	-6.300	0.1314	127	12.600
11	1.000	16.000	0.1317	235	23.400	-6.400	0.1314	128	12.700
12	1.100	15.900	0.1317	236	23.500	-6.500	0.1315	129	12.800
13	1.200	15.800	0.1316	237	23.600	-6.600	0.1315	130	12.900
14	1.300	15.700	0.1317	238	23.700	-6.700	0.1314	131	13.000
15	1.400	15.600	0.1316	239	23.800	-6.800	0.1315	132	13.100
16	1.500	15.500	0.1316	240	23.900	-6.900	0.1316	133	13.200
17	1.600	15.400	0.1317	241	24.000	-7.000	0.1316	134	13.300
18	1.700	15.300	0.1317	242	24.100	-7.100	0.1316	135	13.400
19	1.800	15.200	0.1317	243	24.200	-7.200	0.1316	136	13.500
20	1.900	15.100	0.1317	244	24.300	-7.300	0.1316	137	13.600
21	2.000	15.000	0.1317	245	24.400	-7.400	0.1316	138	13.700
22	2.100	14.900	0.1317	246	24.500	-7.500	0.1316	139	13.800
23	2.200	14.800	0.1317	247	24.600	-7.600	0.1316	140	13.900
24	2.300	14.700	0.1317	248	24.700	-7.700	0.1316	141	14.000
25	2.400	14.600	0.1317	249	24.800	-7.800	0.1316	142	14.100
26	2.500	14.500	0.1317	250	24.900	-7.900	0.1316	143	14.200
27	2.600	14.400	0.1317	251	25.000	-8.000	0.1317	144	14.300
28	2.700	14.300	0.1317	252	25.100	-8.100	0.1317	145	14.400
29	2.800	14.200	0.1317	253	25.200	-8.200	0.1317	146	14.500
30	2.900	14.100	0.1318	254	25.300	-8.300	0.1317	147	14.600
31	3.000	14.000	0.1318	255	25.400	-8.400	0.1317	148	14.700
32	3.100	13.900	0.1318	256	25.500	-8.500	0.1317	149	14.800
33	3.200	13.800	0.1318	257	25.600	-8.600	0.1317	150	14.900
34	3.300	13.700	0.1318	258	25.700	-8.700	0.1317	151	15.000
35	3.400	13.600	0.1318	259	25.800	-8.800	0.1316	152	15.100
36	3.500	13.500	0.1318	260	25.900	-8.900	0.1316	153	15.200
37	3.600	13.400	0.1318	261	26.000	-9.000	0.1316	154	15.300
38	3.700	13.300	0.1317	262	26.100	-9.100	0.1316	155	15.400
39	3.800	13.200	0.1318	263	26.200	-9.200	0.1316	156	15.500
40	3.900	13.100	0.1318	264	26.300	-9.300	0.1316	157	15.600
41	4.000	13.000	0.1318	265	26.400	-9.400	0.1316	158	15.700
42	4.100	12.900	0.1318	266	26.500	-9.500	0.1316	159	15.800
43	4.200	12.800	0.1318	267	26.600	-9.600	0.1316	160	15.900
44	4.300	12.700	0.1318	268	26.700	-9.700	0.1317	161	16.000
45	4.400	12.600	0.1318	269	26.800	-9.800	0.1316	162	16.100
46	4.500	12.500	0.1318	270	26.900	-9.900	0.1316	163	16.200
47	4.600	12.400	0.1318	271	27.000	-10.000	0.1317	164	16.300
48	4.700	12.300	0.1319	272	27.100	-10.100	0.1317	165	16.400
49	4.800	12.200	0.1319	273	27.200	-10.200	0.1317	166	16.500
50	4.900	12.100	0.1319	274	27.300	-10.300	0.1317	167	16.600
51	5.000	12.000	0.1319	275	27.400	-10.400	0.1317	168	16.700
52	5.100	11.900	0.1319	276	27.500	-10.500	0.1317	169	16.800
53	5.200	11.800	0.1319	277	27.600	-10.600	0.1316	170	16.900
54	5.300	11.700	0.1319	278	27.700	-10.700	0.1317	171	17.000
55	5.400	11.600	0.1318	279	27.800	-10.800	0.1317	172	17.100
56	5.500	11.500	0.1318	280	27.900	-10.900	0.1317	173	17.200
57	5.600	11.400	0.1318	281	28.000	-11.000	0.1316	174	17.300
58	5.700	11.300	0.1319	282	28.100	-11.100	0.1317	175	17.400

59	5.800	11.200	0.1319	283	28.200	-11.200	0.1317	176	17.500
60	5.900	11.100	0.1319	284	28.300	-11.300	0.1316	177	17.600
61	6.000	11.000	0.1319	285	28.400	-11.400	0.1316	178	17.700
62	6.100	10.900	0.1318	286	28.500	-11.500	0.1317	179	17.800
63	6.200	10.800	0.1318	287	28.600	-11.600	0.1317	180	17.900
64	6.300	10.700	0.1318	288	28.700	-11.700	0.1316	181	18.000
65	6.400	10.600	0.1319	289	28.800	-11.800	0.1317	182	18.100
66	6.500	10.500	0.1318	290	28.900	-11.900	0.1316	183	18.200
67	6.600	10.400	0.1318	291	29.000	-12.000	0.1316	184	18.300
68	6.700	10.300	0.1318	292	29.100	-12.100	0.1316	185	18.400
69	6.800	10.200	0.1318	293	29.200	-12.200	0.1316	186	18.500
70	6.900	10.100	0.1318	294	29.300	-12.300	0.1315	187	18.600
71	7.000	10.000	0.1318	295	29.400	-12.400	0.1315	188	18.700
72	7.100	9.900	0.1318	296	29.500	-12.500	0.1315	189	18.800
73	7.200	9.800	0.1318	297	29.600	-12.600	0.1315	190	18.900
74	7.300	9.700	0.1318	298	29.700	-12.700	0.1316	191	19.000
75	7.400	9.600	0.1318	299	29.800	-12.800	0.1315	192	19.100
76	7.500	9.500	0.1318	300	29.900	-12.900	0.1316	193	19.200
77	7.600	9.400	0.1318	301	30.000	-13.000	0.1315	194	19.300
78	7.700	9.300	0.1318	302	30.100	-13.100	0.1315	195	19.400
79	7.800	9.200	0.1318	303	30.200	-13.200	0.1315	196	19.500
80	7.900	9.100	0.1317	304	30.300	-13.300	0.1315	197	19.600
81	8.000	9.000	0.1318	305	30.400	-13.400	0.1315	198	19.700
82	8.100	8.900	0.1318	306	30.500	-13.500	0.1314	199	19.800
83	8.200	8.800	0.1318	307	30.600	-13.600	0.1315	200	19.900
84	8.300	8.700	0.1317	308	30.700	-13.700	0.1315	201	20.000
85	8.400	8.600	0.1318	309	30.800	-13.800	0.1315	202	20.100
86	8.500	8.500	0.1317	310	30.900	-13.900	0.1315	203	20.200
87	8.600	8.400	0.1318	311	31.000	-14.000	0.1314	204	20.300
88	8.700	8.300	0.1317	312	31.100	-14.100	0.1314	205	20.400
89	8.800	8.200	0.1317	313	31.200	-14.200	0.1314	206	20.500
90	8.900	8.100	0.1317	314	31.300	-14.300	0.1314	207	20.600
91	9.000	8.000	0.1317	315	31.400	-14.400	0.1314	208	20.700
92	9.100	7.900	0.1317	316	31.500	-14.500	0.1313	209	20.800
93	9.200	7.800	0.1317	317	31.600	-14.600	0.1314	210	20.900
94	9.300	7.700	0.1317	318	31.700	-14.700	0.1313	211	21.000
95	9.400	7.600	0.1317	319	31.800	-14.800	0.1314	212	21.100
96	9.500	7.500	0.1316	320	31.900	-14.900	0.1313	213	21.200
97	9.600	7.400	0.1316	321	32.000	-15.000	0.1313	214	21.300
98	9.700	7.300	0.1316	322	32.100	-15.100	0.1314	215	21.400
99	9.800	7.200	0.1316	323	32.200	-15.200	0.1313	216	21.500
100	9.900	7.100	0.1316	324	32.300	-15.300	0.1314	217	21.600
101	10.000	7.000	0.1316	325	32.400	-15.400	0.1313	218	21.700
102	10.100	6.900	0.1315	326	32.500	-15.500	0.1313	219	21.800
103	10.200	6.800	0.1315	327	32.600	-15.600	0.1313	220	21.900
104	10.300	6.700	0.1316	328	32.700	-15.700	0.1313	221	22.000
105	10.400	6.600	0.1316	329	32.800	-15.800	0.1313	222	22.100
106	10.500	6.500	0.1315	330	32.900	-15.900	0.1313	223	22.200
107	10.600	6.400	0.1315	331	33.000	-16.000	0.1313	224	22.300
108	10.700	6.300	0.1315	332	33.100	-16.100	0.1313		
109	10.800	6.200	0.1315	333	33.200	-16.200	0.1313		
110	10.900	6.100	0.1315	334	33.300	-16.300	0.1313		
111	11.000	6.000	0.1314	335	33.400	-16.400	0.1313		
112	11.100	5.900	0.1315	336	33.500	-16.500	0.1313		
113	11.200	5.800	0.1315	337	33.600	-16.600	0.1314		
114	11.300	5.700	0.1314	338	33.700	-16.700	0.1314		
115	11.400	5.600	0.1300	339	33.800	-16.800	0.1314		
116	11.500	5.500	0.1285	340	33.900	-16.900	0.1315		
117	11.600	5.400	0.1298	341	34.000	-17.000	0.1315		

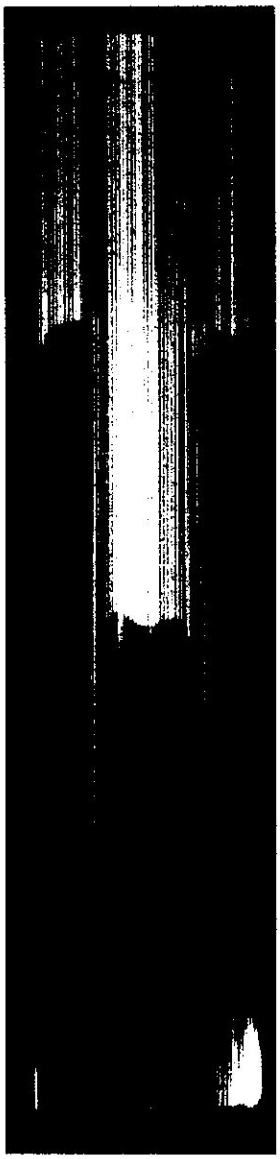
5.44

absdist(mm	1st	2nd	3 rd
5.300	Run	Run	Run
5.200	Reading	Reading	Reading
5.100	Inches	Inches	Inches
5.000			
4.900			D
4.800			
4.700	0.00105		
4.600	0.00085		
4.500	0.00035		
4.400	0.00005		
4.300	0.00000		
4.200	-0.00015		
4.100	-0.00010		
4.000	-0.00020		
3.900	-0.00020		
3.800	-0.00015		
3.700	-0.00020		
3.600	-0.00010		
3.500	-0.00010		
3.400	-0.00010		
3.300	-0.00010		
3.200	-0.00015		
3.100	-0.00015		
3.000	-0.00010		
2.900	-0.00010		
2.800	-0.00010		
2.700	-0.00010		
2.600	-0.00015		
2.500	-0.00010		
2.400	-0.00010		
2.300	-0.00010		
2.200	-0.00015		
2.100	-0.00015		
2.000	-0.00010		
1.900	-0.00015		
1.800	-0.00015		
1.700	-0.00015		
1.600	-0.00015		
1.500	-0.00015		
1.400	-0.00010		
1.300	-0.00010		
1.200	-0.00015		
1.100	-0.00010		
1.000	-0.00010		
0.900	-0.00015		
0.800	-0.00010		
0.700	-0.00010		
0.600	-0.00005		
0.500	-0.00015		
0.400	-0.00010		
0.300	-0.00010		
0.200	-0.00010		
0.100	-0.00010		
0.000	-0.00010		
-0.100	-0.00010		
-0.200	-0.00010		
-0.300	-0.00015		
-0.400	-0.00015		

0.1288

-0.500	-0.00015		
-0.600	-0.00015		
-0.700	-0.00015		
-0.800	-0.00015		
-0.900	-0.00015		
-1.000	-0.00015		
-1.100	-0.00010		
-1.200	-0.00010		
-1.300	-0.00010		
-1.400	-0.00015		
-1.500	-0.00010		
-1.600	-0.00010		
-1.700	-0.00015		
-1.800	-0.00010		
-1.900	-0.00015		
-2.000	-0.00010		
-2.100	-0.00020		
-2.200	-0.00015		
-2.300	-0.00010		
-2.400	-0.00020		
-2.500	-0.00015		
-2.600	-0.00015		
-2.700	-0.00015		
-2.800	-0.00015		
-2.900	-0.00015		
-3.000	-0.00015		
-3.100	-0.00015		
-3.200	-0.00015		
-3.300	-0.00015		
-3.400	-0.00020		
-3.500	-0.00020		
-3.600	-0.00020		
-3.700	-0.00020		
-3.800	-0.00025		
-3.900	-0.00020		
-4.000	-0.00020		
-4.100	-0.00010		
-4.200	0.00050		
-4.300	0.00095		
-4.400	0.00090		
-4.500	0.00070		
-4.600	0.00055		
-4.700	0.00055		
-4.800	0.00045		
-4.900	0.00055		
-5.000	0.00095		
-5.100	0.00110		
-5.200	0.12730		
-5.300			

#469



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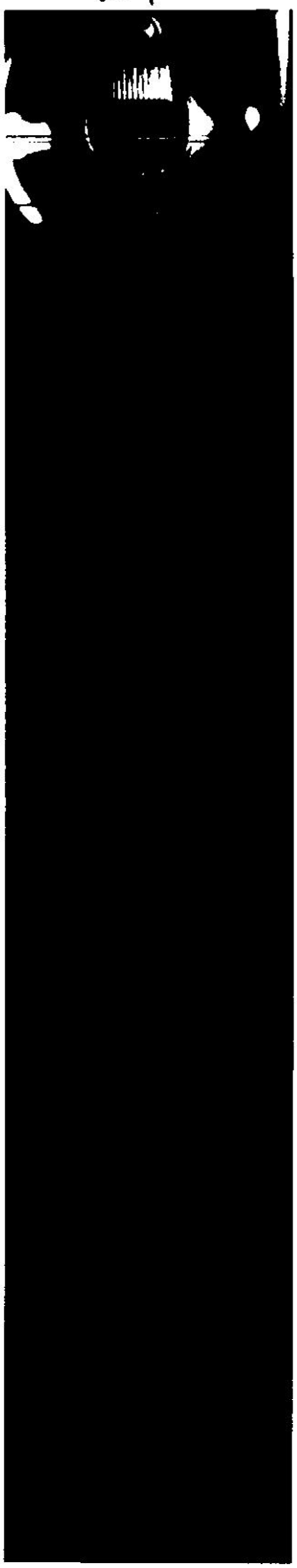
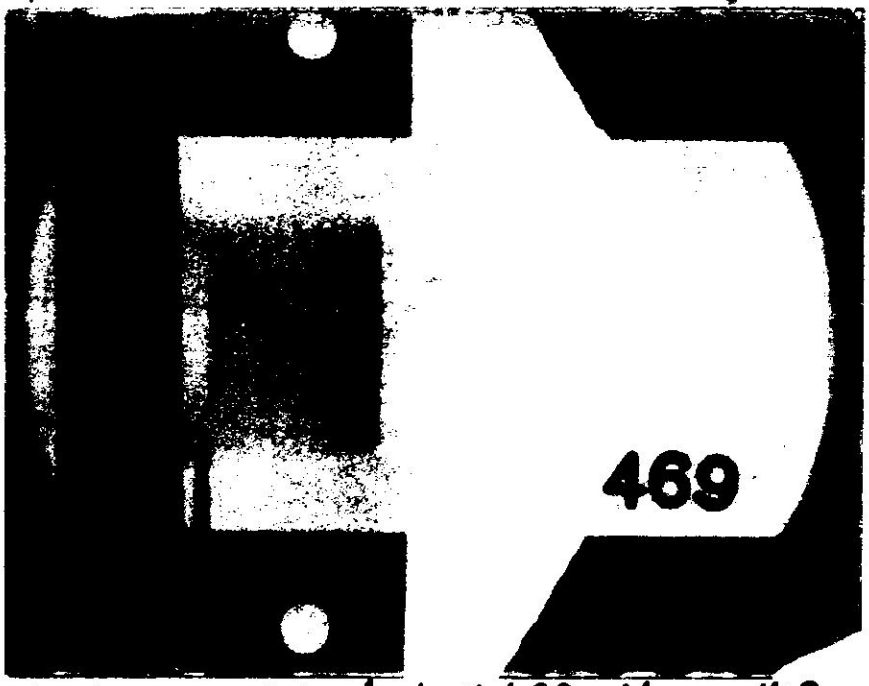
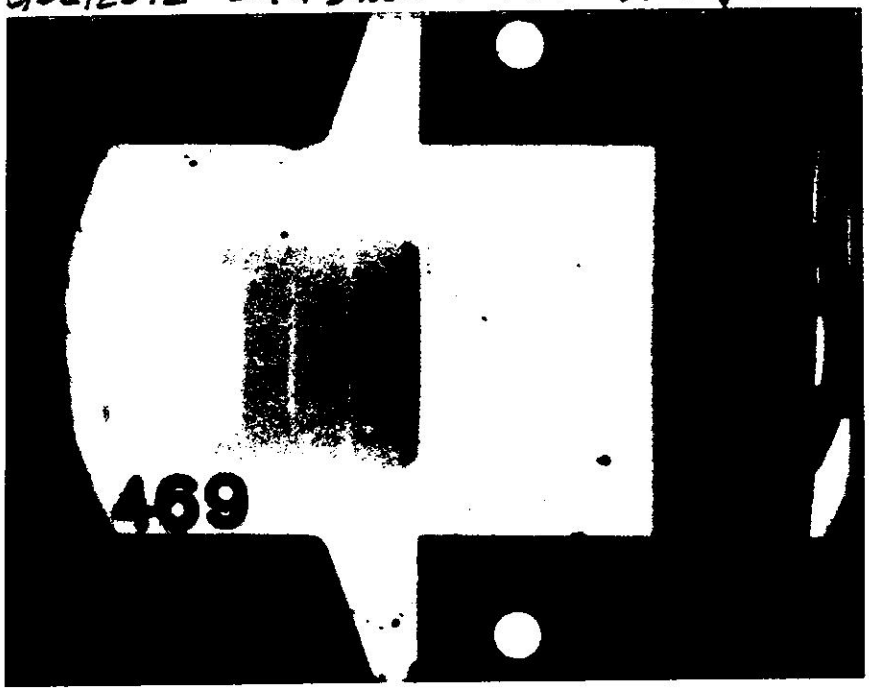


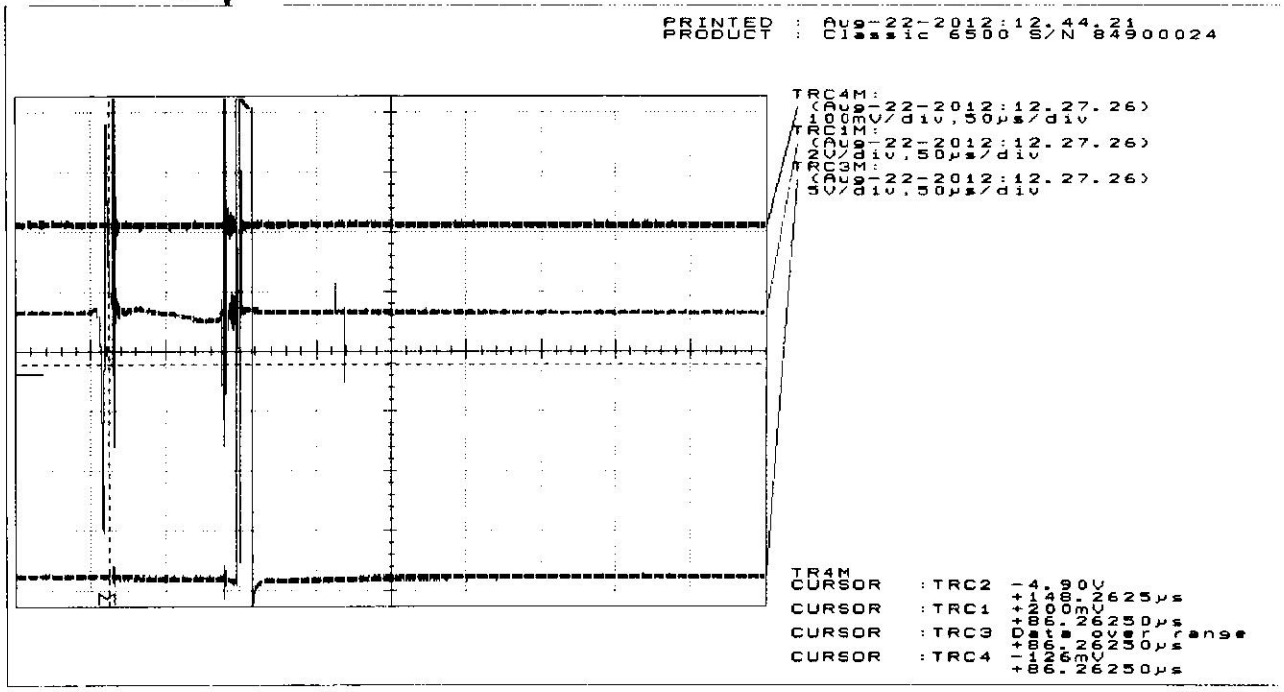
8/22/2012 LGG shot #469 X-ray #1

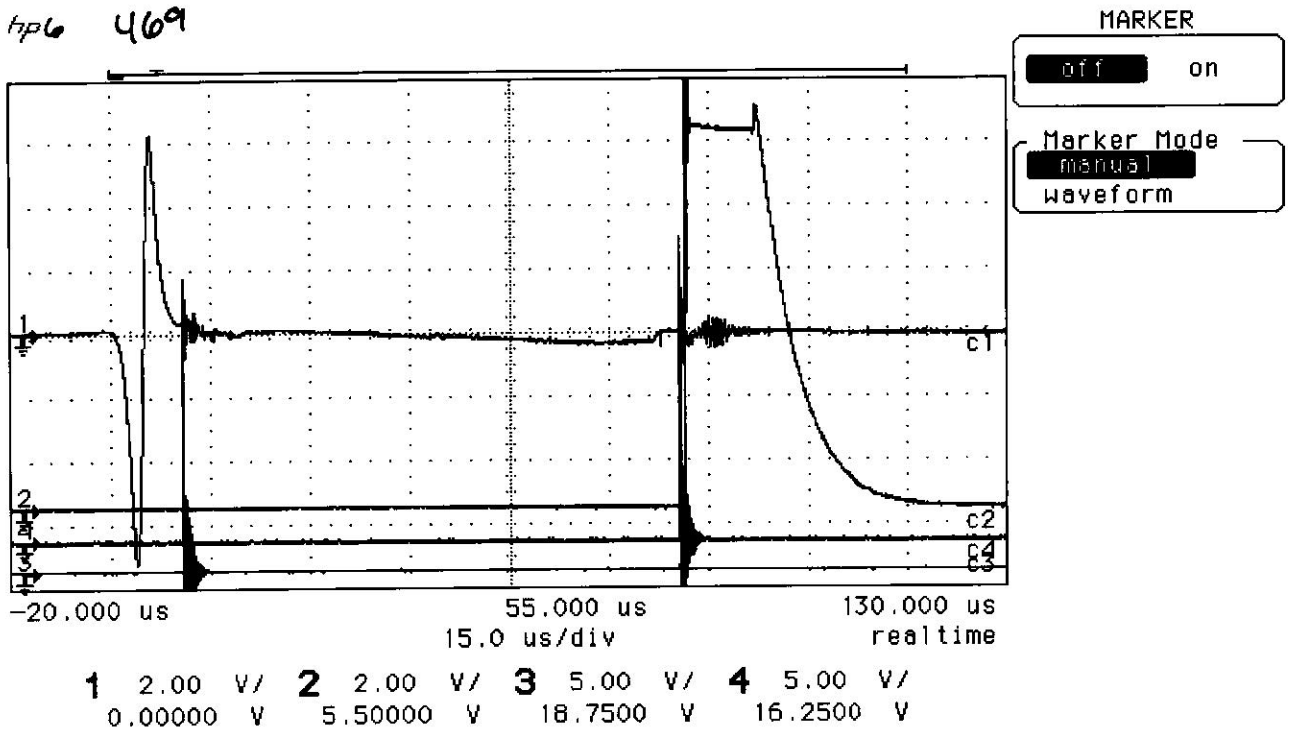


8/22/2012 LGG shot #469 X-ray #2

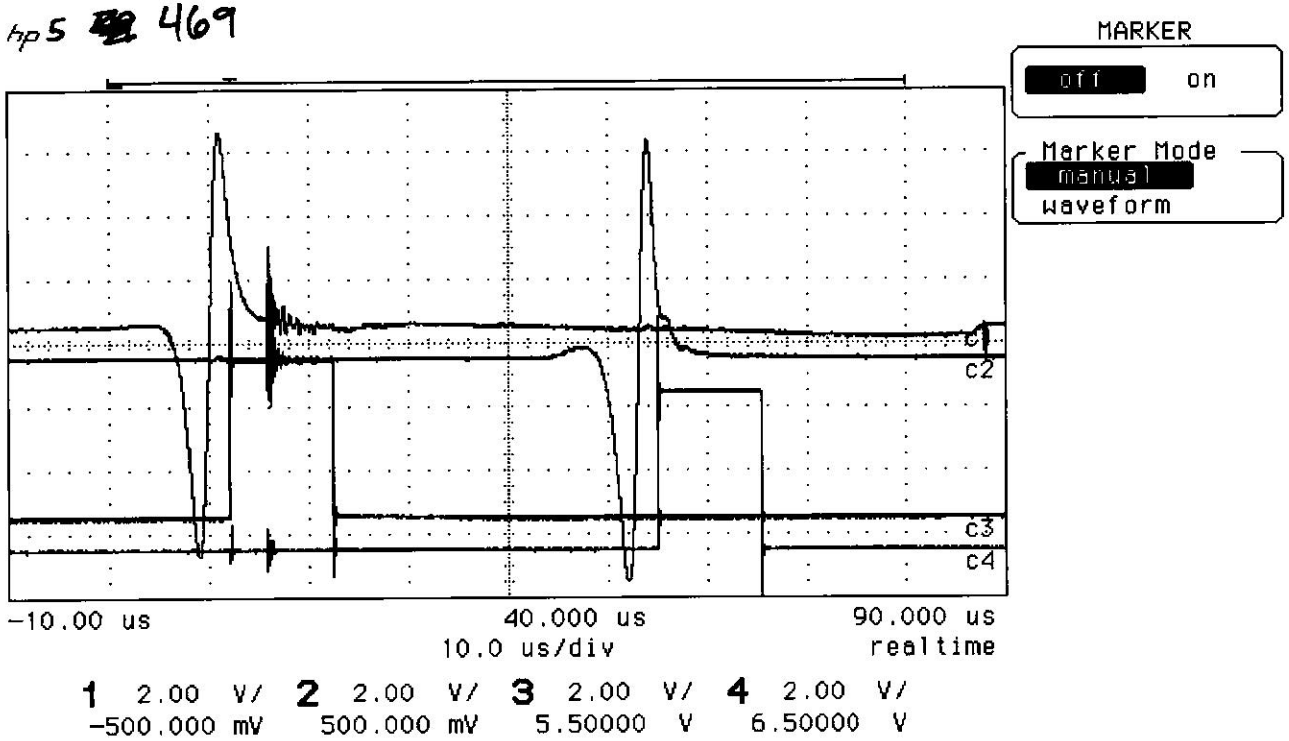


GS7 469


PRINTED : Aug-22-2012:12.44.21
PRODUCT : Classic 6500 S/N 84900024
TRC4M:
(Aug-22-2012:12.27.26)
100mV/div,50µs/div
TRC1M:
(Aug-22-2012:12.27.26)
2V/div,50µs/div
TRC3M:
(Aug-22-2012:12.27.26)
5V/div,50µs/div
TR4M
CURSOR :TRC2 -4.90V
+148.2625µs
CURSOR :TRC1 +200mV
+86.26250µs
CURSOR :TRC3 Data overrange
+86.26250µs
CURSOR :TRC4 -126mV
+86.26250µs


hp6 469
MARKER
off
on
Marker Mode
manual
waveform
c1
c2
c4
c3
-20.000 us
55.000 us
15.0 us/div
130.000 us
realtime
1 2.00 V/ 0.00000 V
2 2.00 V/ 5.50000 V
3 5.00 V/ 18.7500 V
4 5.00 V/ 16.2500 V

hp5 469


MARKER
off
on
Marker Mode
manual
waveform
c1
c2
c3
c4
-10.00 us
40.000 us
10.0 us/div
90.000 us
realtime
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/
-500.000 mV 500.000 mV 5.50000 V 6.50000 V

LIGHT GAS GUN DATA SHEET

Shot No. 470 Date 8-28-12

Target:

Sample Material An-Hd-D. #37 Crystallographic orientation —

Source Location UMich R. Lange Thickness:1 — in.

Type of Measurement EOS Pre-heated 1400°C 2. — in.

Bulk Density — gm/cc Crystal Density — gm/cc

±2 std. devs. — gm/cc ±2 std. devs. — gm/cc

Total Shorting Pin Height — in. Driver Plate Thickness 0.0410 in.
(shim to driver) Material Mo

Projectile:

Weight 20.1237 gms. Length 0.9130 in. Skirt Diameter 1.1129 in.

Flyer Plate Material Mo #4 Leading Edge Dia. 1.1007 in.

Thickness 0.0606 in. Major Dia. 0.9835 in. Depth Inserted 1 in.

Minor Dia. 0.927 in. Pressure 140 lbs

Temp 21°C

Barrel Dimensions:

Breech Diameter _____ in. Muzzle Diameter _____ in. Taper _____ in.

Ellipticity @ projectile depth insertion point _____ in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.111 in.

Diameter: Front 3.494 in. Back 3.497 in.

Pump Tube:

Pre-Fill Pressure _____ in. Hg Fill Pressure _____ psig.

Powder Charge:

Main Charge 538 gms. Type IMR 4350 Total Charge 550 gms.

Primer Charge 12 gms. Type IMR 4350

Expected Velocity:

Projectile 4.7 km/sec Piston 0.577 km/sec

Notes: Temp 1415 (for pyrex windows)
actual 1401 °C

L.G.G.

Camera Streak Duration: 1512 nsec Timing calibration frequency: 147.8950 MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 3.149 µsec Flash X-ray #2 78.286 µsec

Static Streak Photo _____ µsec.

Petal Valve:

Grove Depth:	Total Thickness:
0.0566 in. min.	0.0933 in. min.
0.0569 in. max.	0.0939 in. max

Expected Burst Pressure 4000 psi

Instrument Tank/Vacuum Pump Pressure: 103/108 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	~ cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	522 µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	1053 µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	42.500 ~~74.574~~ µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	74.574 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	81.286 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	6.717 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	74.607 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	42.5 µsec
UDC Velocity:			4791.17 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	152.20 ns
HP5, 2:	Velocity magnet 2	42.6417 µsec
HP5, 3:	TTL Start	23694 µsec
HP5, 4:	TTL Stop	44.6428 µsec
HP6, 1:	Velocity Magnet 1	136.20 ns
HP6,2:	Xenon Lamp Trigger	80.4086 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	5.8548 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	80.463 µsec
GS7, 1:	Velocity Magnet 1	−1.7995 µsec
GS7,3:	Camera Trigger (UDC HV 1)	84.83150 µsec
GS7, 4:	Camera Monitor Out	85.0475 µsec

SHOT SIMULATION

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	44.100 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	74.398 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	84.386 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	9.992 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	74.398 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	44.050 µsec
UDC Velocity:			4621.87 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	450.0 ns
HP5, 2:	Velocity magnet 2	44.52186 µsec
HP5, 3:	TTL Start	2.46666 µsec
HP5, 4:	TTL Stop	46.5184 µsec
HP6, 1:	Velocity Magnet 1	422.40 ns
HP6,2:	Xenon Lamp Trigger	83.7882 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	6.1530 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	80.5526 µsec
GS7, 1:	Velocity Magnet 1	-1.4337 µsec
GS7, 2:	Camera Cal. Sig.	88.9565 µsec
GS7,3:	Camera Trigger (UDC HV 1)	88.280 µsec
GS7, 4:	Camera Monitor Out	88.495 µsec

Shot 470 Nominal Timeline Preshot

V	4700			meters	mag SIM time	43320 ns			
cable time	90	150	M1-M2 distance	0.203606					
intervalometer intrinsic delay	[redacted]		M2-target distance	0.215913					
UDC extra count lag	[redacted]		M2-target fudge	[redacted]					
pulse translator delay	150		M1-fid1 distance	0.03					
X-ray 1 program delay	[redacted]	3149 X-ray 1 actual delay	M1-fid2 distance	0.383145					
X-ray 2 program delay	[redacted]	78286 X-ray 2 actual delay	Flyer thickness	0.00153924					
X-ray 1 pulser delay	600								
X-ray 2 pulser delay	[redacted]		Us(Mo)	7991.63874					
Camera intrinsic delay	107		driver thickness	0.0010414					
Lamp trigger to peak brightness	7127		cap thickness	0.00076987					
HV#3 delay to lamp	-6370		estimated sample+cover time	227.826421					
Streak duration	1514								
Desired dead streak before driver	500								

t (ns)	flyer x (m)	shock front (m)	event				
0	0.00076962		M1 zero-crossing				
150	0.00147462		HP5-1, GS7-1, HP6-1, Intervalometer start			X-ray velocity	4700
2230	0.01125062		HP5-3, UDC start, signal to pulse translator				On film
2380	0.01195562		pulse translator out		X-ray 1 flyer vs. fid (mm)	-0.00108	-0.0012558
5529	0.02675592		X-ray 1 delay amp out to counters 4, 5				
6219	0.02999892		X-ray 1 fires				
6309	0.03042192		X-ray 1 pulse monitor at counter 4b				
43320	0.20437562		M2 zero-crossing	Counter 3:	43320		
43470	0.20508062		HP5-2, Intervalometer stop			HP5 2-1	43320
45550	0.21485662		HP5-4, UDC stop	UDC upcount:	43320	HP5 4-3	43320
80666	0.37989982		X-ray 2 delay amp, stop counter 4, start counter 6	Counter 4:	75137		
81381	0.38326032		X-ray 2 fires		X-ray 2 flyer vs. fid (mm)	0.11532	0.13409302
81471	0.38368332		X-ray 2 pulse monitor at counter 4b	Counter 4b:	75162		
88529	0.41685556		UDC out, GS7-3, stop counters 5 and 6	Counter 5:	83000	GS7 3-1	88379
88619	0.41727856		Trigger at camera	Counter 6:	7863	GS7 4-1	88666
88726	0.41778146		Begin Streak				
88816	0.41820446		Camera Monitor on GS7-4			HP6-1	
89096	0.419519	0	IMPACT				
89226		0.0010414	Driver arrival on streak				
89454		0.002862106	Sample cutoff on streak				
90240		0.009144922	End Streak				

Driver cutoff on streak	500
Sample cutoff on sreak	728

	rho0	Co	s				
Cold Mo	10206	5033	1.28946405				
Hot Mo	9937	4918.5831	1.28837124	1407			
Liquid An-Di-Ha	[redacted]						

				up	P	Us
driver	357.7250824	-223949297	5.32134E+11	2385.22527	189.417689	**7991.63874**
sample	8929.672302	-178815519	5.2451E+11	3569.5375	77.1595075	**7894.91079**
cap	-8929.6723	-111965161	2.53012E+11	1954.93783	144.477998	**7437.26877**

	scopes			
trig	HP5-1	0	10V pp	rising
	HP5-2	43320	10V pp	rising
	HP5-3	-2080	5 V _-_	
	HP5-4	45400	5 V _-_	
trig	HP6-1	0	10V pp	rising
HV#1-14.3us	HP6-2	82159	10 V _-_	
	HP6-3	6159	25 V /\	
	HP6-4	81321	25 V /\	
trig	GS7-1	0	10V pp	rising
sim only	GS7-2	89029	10 V _-_	ttl
	GS7-3	88379	40 V _-_	
	GS7-4	88666	(-)1.75 V	down going

45 200ns

500 ns

50 µs

MAGNET DISTANCE

Shot No. **470** Expected Velocity: **4.70**

Magnet # 2 Magnet # 1

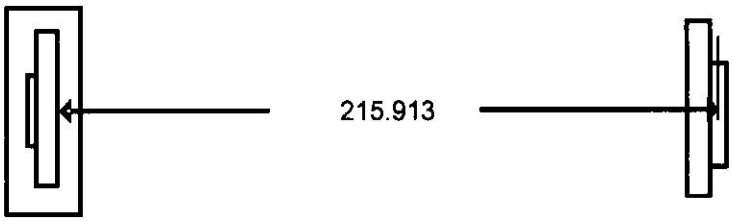
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **43.321 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Target Magnet # 2

Micrometer Measurement

First measurement = 8.377 inch

Second measurement = 8.374 inch

Average measurement = 8.376 inch

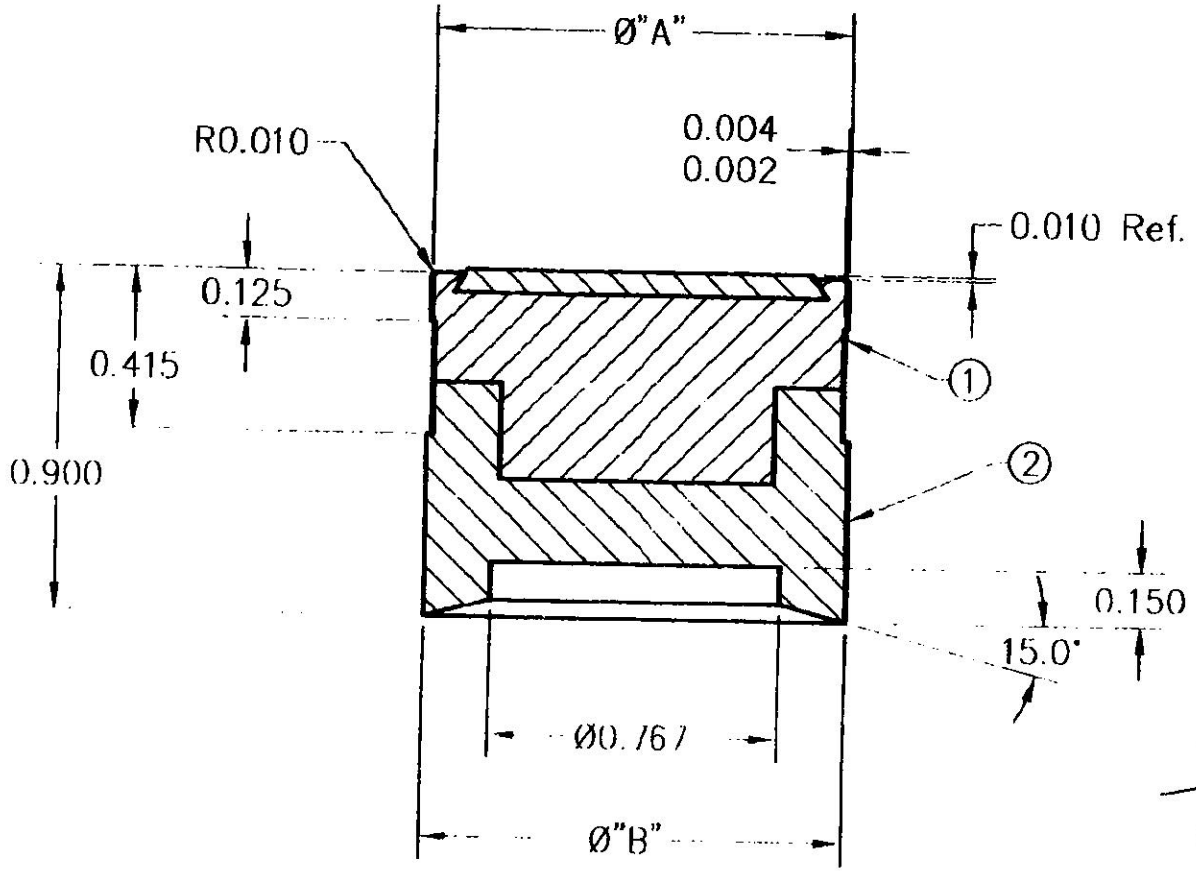
Average measurement = 212.738 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

Distance Between Magnet # 2 to Target = 215.913 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **45.939 µsec.**

Fudged Distance between Magnet 2 to Target = 202.954 mm ~ 201 421



Mo# #4

20.1237gms

Built As

SHOT#		
A	1.1007	+.0000 -.0005
B	1.1125	+.0005 -.0000

1.1007
1.1129

Note: Super Glue & Press Fit 1 & 2

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-128	1
1	Sabot & Flyer Plate	LGG-157	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN: M. Long — DATE: 11/29/10
ENGINEER — DATE
APPROVED — DATE

MATERIAL: Zelux-M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: Projectile Assy. for 28mm launch tube (GM)

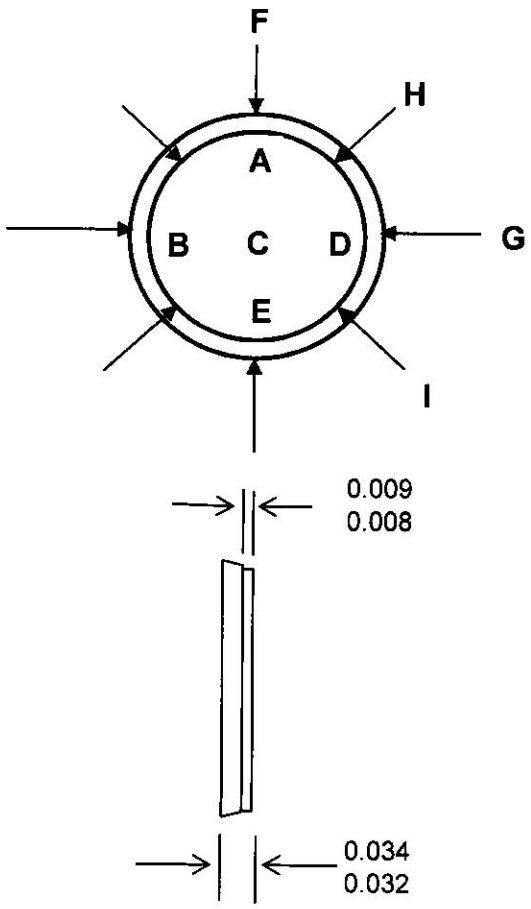
SCALE: 2:1 | SHEET: 2 of 2 | A | DRAWING NUMBER: LGG-158

SHOT No.

FLYER PLATE MATERIAL: **Mo 4** 7/5/2012

Measurement done by: Emma

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06065	F	0.98350
A	0.06070	F	0.98300
B	0.06040	G	0.98400
B	0.06050	G	0.98350
C	0.06070	H	0.92700
C	0.06065	H	0.92700
D	0.06070	I	0.92700
D	0.06075	I	0.92700
E	0.06045		
E	0.06050		



Statistic for thickness

N	10
MAX	0.06075
MIN	0.06040
Range	0.00035
MEAN	0.06060
	1.53924 mm
STDEV	0.000124722

Statistic for Diameter (F-G)

N	4
MAX	0.98400
MIN	0.98300
Range	0.00100
MEAN	0.9835000 inch
	24.9809000 mm
STDEV	0.000408248

Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927 inch
	23.5458 mm
STDEV	0

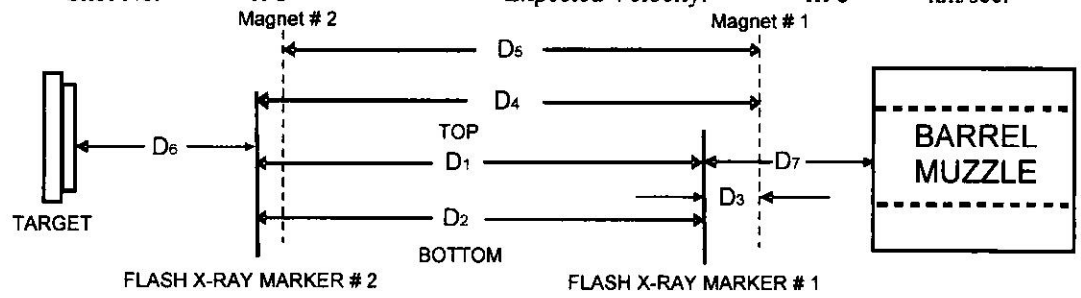
	Sample in Air	Crystal Density	
1	7.17191	10.22	
2	7.17192	10.22	
3	7.17193	10.22	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.06060	±	in
FLATNESS:	0.00035	in.	
VOLUME:			cm^3
CRYSTAL DENSITY:	10.2190		$grams/cm^3$
BULK DENSITY:	#DIV/0!		$grams/cm^3$
DENSITIES CHECKED BY: _____ on _____			
MEASUREMENT CHECKED B	Emma	7/5/2012	

TARGET MEASUREMENT

Shot No. **470** Expected Velocity: **4.70** km/sec.



	D_3, Magnet # 1 to Flash X-Ray Marker # 1	D_4, Magnet # 1 to Flash X-Ray Marker # 2	D_5, Magnet # 1 to Magnet # 2	D_6, Target to Flash X-Ray Marker # 2	D_7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	8.375	99.0
Measure # 2, mm	30.00	383.15	203.66	8.377	99.0
Average, mm	30.00	383.15	203.61	8.376	99.0
Travel time, µsec	**6.38**	**81.52**	**43.32**	**1.78**	**21.06**

Top

D_1, Flash X-Ray fiducial distance 1: 353.19 mm
D_1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **75.15** µsec.

Bottom

D_2, Flash X-Ray fiducial distance 1: 353.09 mm
D_2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

Average distance between D_1 and D_2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **75.12** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **3.28** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **78.87** µsec.

sheet values
3.149 ns
78.286 ns

SHOT No. ____470_____ tip used: .7mm long/ flat tip

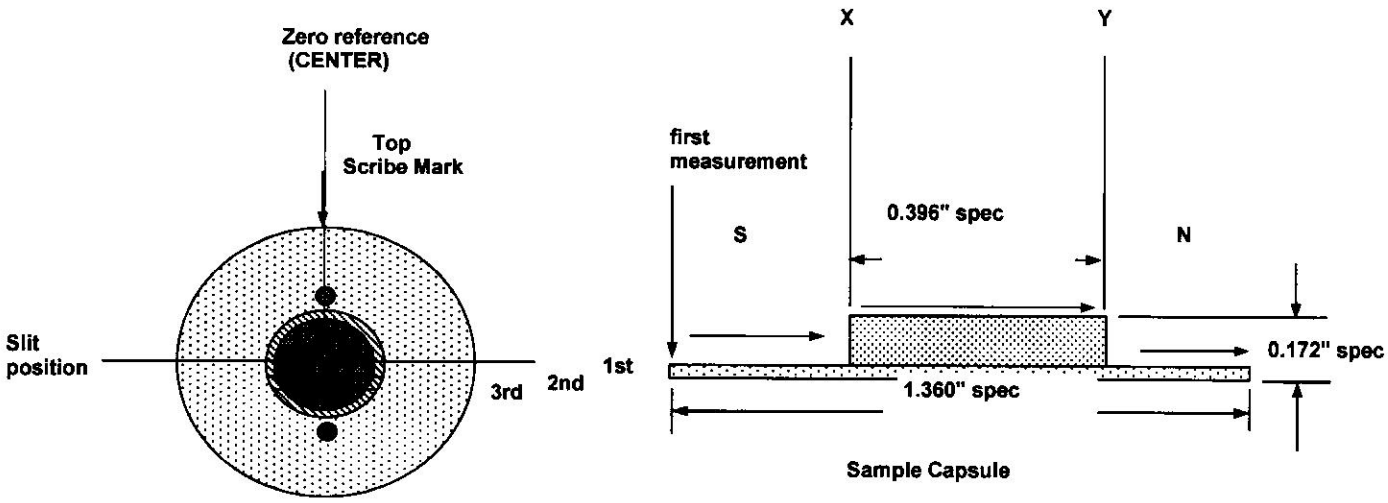
SAMPLE CAPSULE: 37

SAMPLE MATERIAL: An-Di-Hd

direction of measurement

2.27

THICKNESS PROFILE (Not re-polished, but final surface) 5.335



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

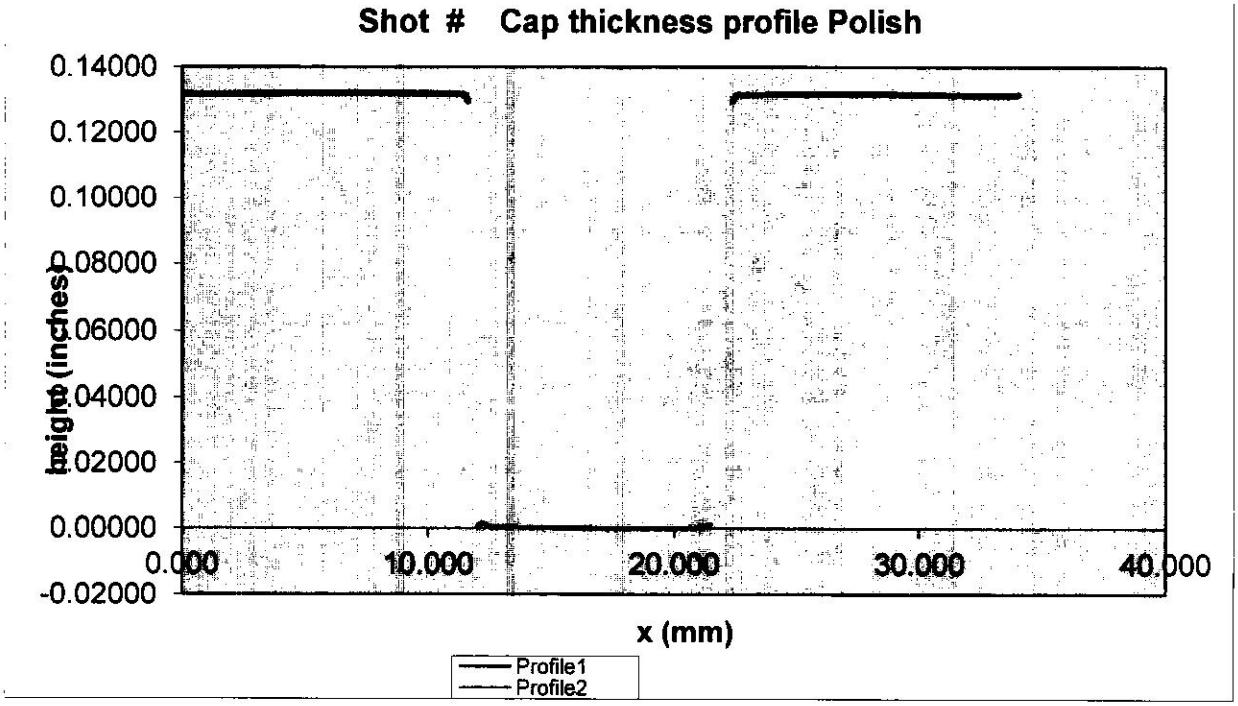
Average thickness reading = 0.00015

Note: Measurement from reference zero point from the base is = **-0.1724** Inches
-4.3790 mm

Average thickness of the driver Plate = -0.0410 Inches
-1.0410 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1
Profile2

1. First Run Horizontal (X) thru the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s	# reading	dist(mm)
1	0.000	17.000	0.1319	225	22.400	-5.400	0.1291	118	11.700
2	0.100	16.900	0.1318	226	22.500	-5.500	0.1311	119	11.800
3	0.200	16.800	0.1317	227	22.600	-5.600	0.1311	120	11.900
4	0.300	16.700	0.1317	228	22.700	-5.700	0.1311	121	12.000
5	0.400	16.600	0.1316	229	22.800	-5.800	0.1310	122	12.100
6	0.500	16.500	0.1316	230	22.900	-5.900	0.1310	123	12.200
7	0.600	16.400	0.1316	231	23.000	-6.000	0.1311	124	12.300
8	0.700	16.300	0.1315	232	23.100	-6.100	0.1312	125	12.400
9	0.800	16.200	0.1315	233	23.200	-6.200	0.1311	126	12.500
10	0.900	16.100	0.1315	234	23.300	-6.300	0.1311	127	12.600
11	1.000	16.000	0.1315	235	23.400	-6.400	0.1312	128	12.700
12	1.100	15.900	0.1315	236	23.500	-6.500	0.1312	129	12.800
13	1.200	15.800	0.1315	237	23.600	-6.600	0.1312	130	12.900
14	1.300	15.700	0.1315	238	23.700	-6.700	0.1313	131	13.000
15	1.400	15.600	0.1315	239	23.800	-6.800	0.1312	132	13.100
16	1.500	15.500	0.1316	240	23.900	-6.900	0.1312	133	13.200
17	1.600	15.400	0.1315	241	24.000	-7.000	0.1312	134	13.300
18	1.700	15.300	0.1315	242	24.100	-7.100	0.1313	135	13.400
19	1.800	15.200	0.1315	243	24.200	-7.200	0.1312	136	13.500
20	1.900	15.100	0.1316	244	24.300	-7.300	0.1313	137	13.600
21	2.000	15.000	0.1316	245	24.400	-7.400	0.1313	138	13.700
22	2.100	14.900	0.1316	246	24.500	-7.500	0.1313	139	13.800
23	2.200	14.800	0.1316	247	24.600	-7.600	0.1313	140	13.900
24	2.300	14.700	0.1316	248	24.700	-7.700	0.1313	141	14.000
25	2.400	14.600	0.1316	249	24.800	-7.800	0.1313	142	14.100
26	2.500	14.500	0.1317	250	24.900	-7.900	0.1313	143	14.200
27	2.600	14.400	0.1317	251	25.000	-8.000	0.1313	144	14.300
28	2.700	14.300	0.1317	252	25.100	-8.100	0.1313	145	14.400
29	2.800	14.200	0.1317	253	25.200	-8.200	0.1314	146	14.500
30	2.900	14.100	0.1317	254	25.300	-8.300	0.1313	147	14.600
31	3.000	14.000	0.1317	255	25.400	-8.400	0.1314	148	14.700
32	3.100	13.900	0.1317	256	25.500	-8.500	0.1313	149	14.800
33	3.200	13.800	0.1317	257	25.600	-8.600	0.1314	150	14.900
34	3.300	13.700	0.1317	258	25.700	-8.700	0.1314	151	15.000
35	3.400	13.600	0.1317	259	25.800	-8.800	0.1313	152	15.100
36	3.500	13.500	0.1317	260	25.900	-8.900	0.1314	153	15.200
37	3.600	13.400	0.1317	261	26.000	-9.000	0.1314	154	15.300
38	3.700	13.300	0.1318	262	26.100	-9.100	0.1314	155	15.400
39	3.800	13.200	0.1317	263	26.200	-9.200	0.1314	156	15.500
40	3.900	13.100	0.1318	264	26.300	-9.300	0.1314	157	15.600
41	4.000	13.000	0.1318	265	26.400	-9.400	0.1314	158	15.700
42	4.100	12.900	0.1318	266	26.500	-9.500	0.1315	159	15.800
43	4.200	12.800	0.1318	267	26.600	-9.600	0.1314	160	15.900
44	4.300	12.700	0.1318	268	26.700	-9.700	0.1315	161	16.000
45	4.400	12.600	0.1318	269	26.800	-9.800	0.1314	162	16.100
46	4.500	12.500	0.1318	270	26.900	-9.900	0.1314	163	16.200
47	4.600	12.400	0.1318	271	27.000	-10.000	0.1314	164	16.300
48	4.700	12.300	0.1318	272	27.100	-10.100	0.1315	165	16.400
49	4.800	12.200	0.1318	273	27.200	-10.200	0.1314	166	16.500
50	4.900	12.100	0.1318	274	27.300	-10.300	0.1314	167	16.600
51	5.000	12.000	0.1318	275	27.400	-10.400	0.1314	168	16.700
52	5.100	11.900	0.1319	276	27.500	-10.500	0.1314	169	16.800
53	5.200	11.800	0.1319	277	27.600	-10.600	0.1314	170	16.900
54	5.300	11.700	0.1319	278	27.700	-10.700	0.1314	171	17.000
55	5.400	11.600	0.1319	279	27.800	-10.800	0.1314	172	17.100
56	5.500	11.500	0.1319	280	27.900	-10.900	0.1314	173	17.200
57	5.600	11.400	0.1319	281	28.000	-11.000	0.1314	174	17.300
58	5.700	11.300	0.1319	282	28.100	-11.100	0.1314	175	17.400

59	5.800	11.200	0.1319	283	28.200	-11.200	0.1314	176	17.500
60	5.900	11.100	0.1319	284	28.300	-11.300	0.1314	177	17.600
61	6.000	11.000	0.1319	285	28.400	-11.400	0.1314	178	17.700
62	6.100	10.900	0.1319	286	28.500	-11.500	0.1314	179	17.800
63	6.200	10.800	0.1319	287	28.600	-11.600	0.1314	180	17.900
64	6.300	10.700	0.1319	288	28.700	-11.700	0.1314	181	18.000
65	6.400	10.600	0.1319	289	28.800	-11.800	0.1314	182	18.100
66	6.500	10.500	0.1319	290	28.900	-11.900	0.1314	183	18.200
67	6.600	10.400	0.1319	291	29.000	-12.000	0.1313	184	18.300
68	6.700	10.300	0.1319	292	29.100	-12.100	0.1313	185	18.400
69	6.800	10.200	0.1319	293	29.200	-12.200	0.1313	186	18.500
70	6.900	10.100	0.1319	294	29.300	-12.300	0.1313	187	18.600
71	7.000	10.000	0.1319	295	29.400	-12.400	0.1313	188	18.700
72	7.100	9.900	0.1319	296	29.500	-12.500	0.1313	189	18.800
73	7.200	9.800	0.1319	297	29.600	-12.600	0.1313	190	18.900
74	7.300	9.700	0.1319	298	29.700	-12.700	0.1312	191	19.000
75	7.400	9.600	0.1318	299	29.800	-12.800	0.1313	192	19.100
76	7.500	9.500	0.1319	300	29.900	-12.900	0.1312	193	19.200
77	7.600	9.400	0.1319	301	30.000	-13.000	0.1312	194	19.300
78	7.700	9.300	0.1319	302	30.100	-13.100	0.1313	195	19.400
79	7.800	9.200	0.1318	303	30.200	-13.200	0.1312	196	19.500
80	7.900	9.100	0.1319	304	30.300	-13.300	0.1312	197	19.600
81	8.000	9.000	0.1318	305	30.400	-13.400	0.1312	198	19.700
82	8.100	8.900	0.1318	306	30.500	-13.500	0.1312	199	19.800
83	8.200	8.800	0.1318	307	30.600	-13.600	0.1311	200	19.900
84	8.300	8.700	0.1318	308	30.700	-13.700	0.1311	201	20.000
85	8.400	8.600	0.1318	309	30.800	-13.800	0.1311	202	20.100
86	8.500	8.500	0.1318	310	30.900	-13.900	0.1311	203	20.200
87	8.600	8.400	0.1318	311	31.000	-14.000	0.1311	204	20.300
88	8.700	8.300	0.1318	312	31.100	-14.100	0.1311	205	20.400
89	8.800	8.200	0.1318	313	31.200	-14.200	0.1311	206	20.500
90	8.900	8.100	0.1318	314	31.300	-14.300	0.1310	207	20.600
91	9.000	8.000	0.1318	315	31.400	-14.400	0.1310	208	20.700
92	9.100	7.900	0.1317	316	31.500	-14.500	0.1311	209	20.800
93	9.200	7.800	0.1317	317	31.600	-14.600	0.1311	210	20.900
94	9.300	7.700	0.1317	318	31.700	-14.700	0.1311	211	21.000
95	9.400	7.600	0.1317	319	31.800	-14.800	0.1310	212	21.100
96	9.500	7.500	0.1317	320	31.900	-14.900	0.1310	213	21.200
97	9.600	7.400	0.1317	321	32.000	-15.000	0.1310	214	21.300
98	9.700	7.300	0.1316	322	32.100	-15.100	0.1310	215	21.400
99	9.800	7.200	0.1316	323	32.200	-15.200	0.1309	216	21.500
100	9.900	7.100	0.1316	324	32.300	-15.300	0.1310	217	21.600
101	10.000	7.000	0.1316	325	32.400	-15.400	0.1309	218	21.700
102	10.100	6.900	0.1316	326	32.500	-15.500	0.1309	219	21.800
103	10.200	6.800	0.1316	327	32.600	-15.600	0.1309	220	21.900
104	10.300	6.700	0.1316	328	32.700	-15.700	0.1309	221	22.000
105	10.400	6.600	0.1316	329	32.800	-15.800	0.1309	222	22.100
106	10.500	6.500	0.1315	330	32.900	-15.900	0.1309	223	22.200
107	10.600	6.400	0.1315	331	33.000	-16.000	0.1309	224	22.300
108	10.700	6.300	0.1315	332	33.100	-16.100	0.1309		
109	10.800	6.200	0.1315	333	33.200	-16.200	0.1309		
110	10.900	6.100	0.1315	334	33.300	-16.300	0.1309		
111	11.000	6.000	0.1314	335	33.400	-16.400	0.1309		
112	11.100	5.900	0.1314	336	33.500	-16.500	0.1309		
113	11.200	5.800	0.1314	337	33.600	-16.600	0.1309		
114	11.300	5.700	0.1314	338	33.700	-16.700	0.1310		
115	11.400	5.600	0.1315	339	33.800	-16.800	0.1310		
116	11.500	5.500	0.1310	340	33.900	-16.900	0.1310		
117	11.600	5.400	0.1292	341	34.000	-17.000	0.1311		
			5.3900						

absdist(mm	1st	2nd	3 rd
5.300	Run	Run	Run
5.200	Reading	Reading	Reading
5.100	Inches	Inches	Inches
5.000			
4.900			
4.800			
4.700	0.00060		
4.600	0.00120		
4.500	0.00160		
4.400	0.00130		
4.300	0.00085		
4.200	0.00050		
4.100	0.00045		
4.000	0.00035		
3.900	0.00045		
3.800	0.00040		
3.700	0.00040		
3.600	0.00035		
3.500	0.00035		
3.400	0.00035		
3.300	0.00030		
3.200	0.00030		
3.100	0.00030		
3.000	0.00025		
2.900	0.00020		
2.800	0.00020		
2.700	0.00020		
2.600	0.00015		
2.500	0.00015		
2.400	0.00015		
2.300	0.00010		
2.200	0.00010		
2.100	0.00010		
2.000	0.00010		
1.900	0.00010		
1.800	0.00010		
1.700	0.00010		
1.600	0.00005		
1.500	0.00005		
1.400	0.00005		
1.300	0.00000		
1.200	0.00000		
1.100	0.00000		
1.000	0.00005		
0.900	0.00000		
0.800	0.00000		
0.700	0.00000		
0.600	0.00000		
0.500	0.00000		
0.400	0.00000		
0.300	0.00000		
0.200	0.00000		
0.100	0.00000		
0.000	0.00000		
-0.100	0.00000		
-0.200	-0.00005		
-0.300	-0.00005		
-0.400	-0.00005		

-0.500	-0.00005		
-0.600	-0.00010		
-0.700	-0.00010		
-0.800	-0.00010		
-0.900	-0.00005		
-1.000	-0.00005		
-1.100	-0.00010		
-1.200	-0.00010		
-1.300	-0.00010		
-1.400	-0.00010		
-1.500	-0.00010		
-1.600	-0.00010		
-1.700	-0.00010		
-1.800	-0.00010		
-1.900	-0.00010		
-2.000	-0.00010		
-2.100	-0.00015		
-2.200	-0.00010		
-2.300	-0.00010		
-2.400	-0.00005		
-2.500	-0.00005		
-2.600	-0.00010		
-2.700	-0.00005		
-2.800	-0.00005		
-2.900	-0.00005		
-3.000	-0.00005		
-3.100	-0.00005		
-3.200	-0.00005		
-3.300	0.00000		
-3.400	-0.00005		
-3.500	0.00000		
-3.600	0.00000		
-3.700	0.00000		
-3.800	0.00000		
-3.900	0.00005		
-4.000	-0.00005		
-4.100	-0.00010		
-4.200	0.00000		
-4.300	0.00030		
-4.400	0.00065		
-4.500	0.00080		
-4.600	0.00085		
-4.700	0.00095		
-4.800	0.00105		
-4.900			
-5.000			
-5.100			
-5.200			
-5.300			

SHOT No. _____470_____

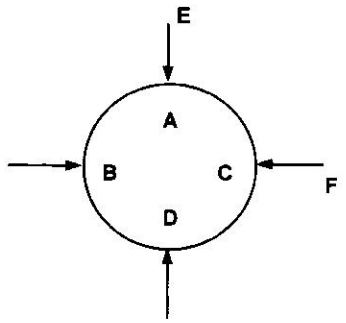
LGG Moly Capsule Cap

SAMPLE MATERIAL: Mo 37

11/24/2010

Post polish

Thickness Measurement	
A	0.03010
A	0.03035
B	0.03035
B	0.03020
C	0.03035
C	0.03035
D	0.03045
D	0.03035



Diameter Measurement	
E	0.35350
E	0.35350
F	0.35350
F	0.35400
AVE	0.35363
Radius	0.1768

Statistic for thickness	
N	8
MAX	0.03045
MIN	0.0301
Range	0.00035
MEAN	0.03031
STDEV	0.000109381

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.353625
STDEV	0.00025

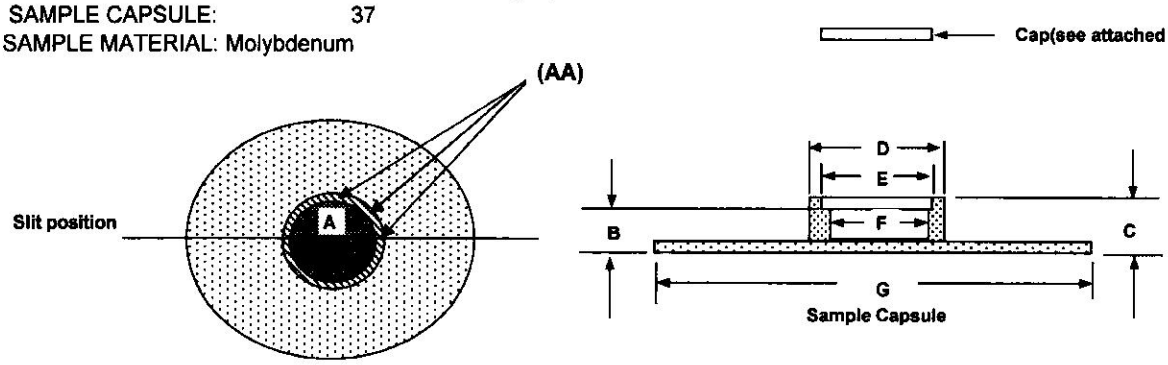
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.0303125	±	mm	
	FLATNESS:		0.00035			
	VOLUME:		0.0488		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.1927		$grams/cm^3$	

SHOT No.: 470 prepolish 11/18/2010

SAMPLE CAPSULE: 37

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04130
A	0.04145
A	0.04140
A	0.04135
Avg	0.04138

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3535
F	0.3140
F	0.3140

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17180
C	0.17180
C	0.17185
C	0.17180
D	0.3960
D	0.3960
G	1.3590
G	1.3595
H	0.10116

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14240
B point 2	0.14210
B point 3	0.14295
B point 4	0.14295
B point 5	0.14285
B point 6	0.14250
B point 7	0.14240
B point 8	0.14215

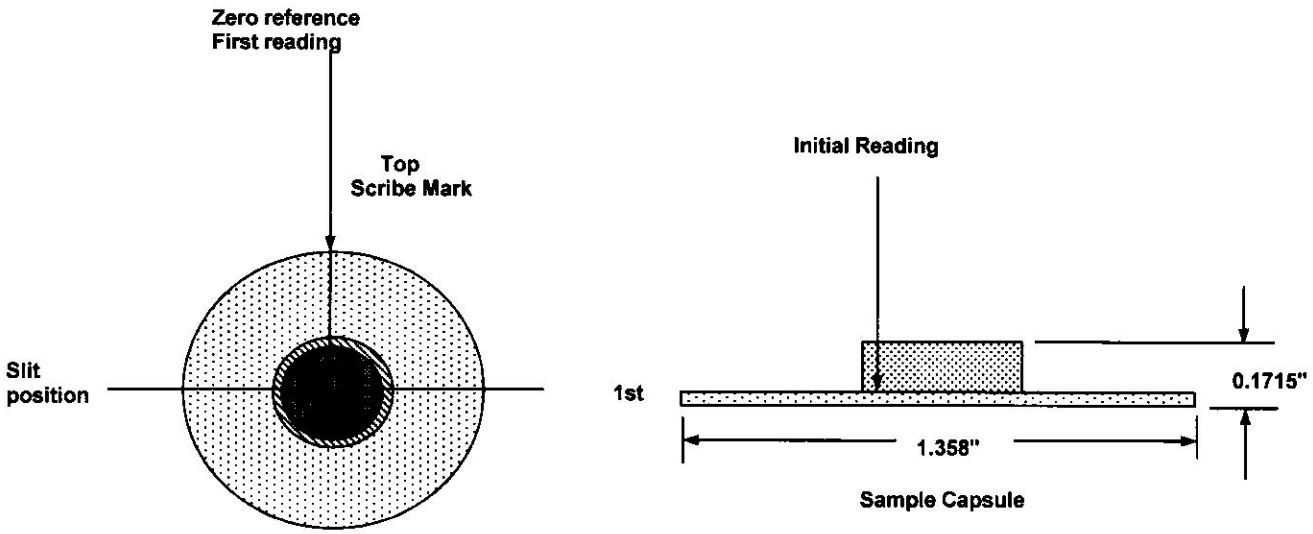
Statistics

N	8
MAX	0.14295
MIN	0.14210
Range	0.00085
Average	0.14254

MEASUREMENT BY:		Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

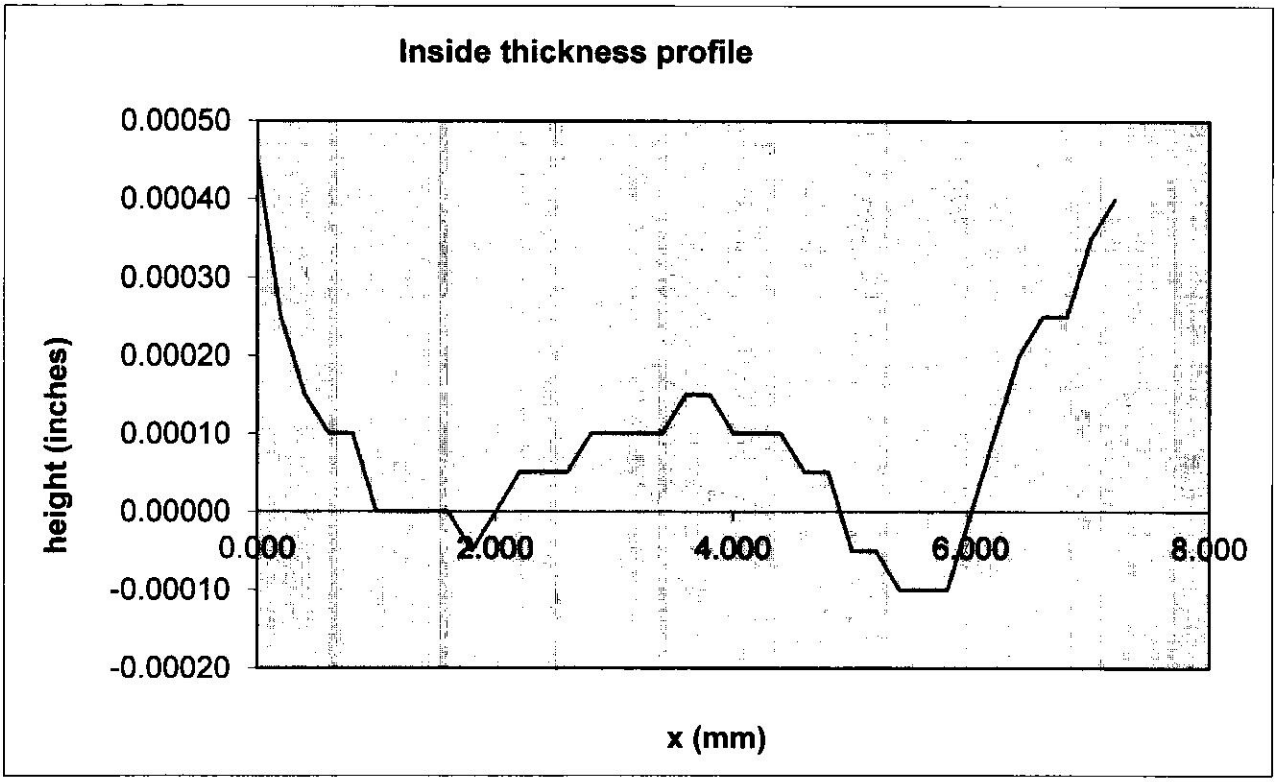
SAMPLE CAPSULE: **37**
SAMPLE MATERIAL: **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER



Average thickness reading = 0.00009

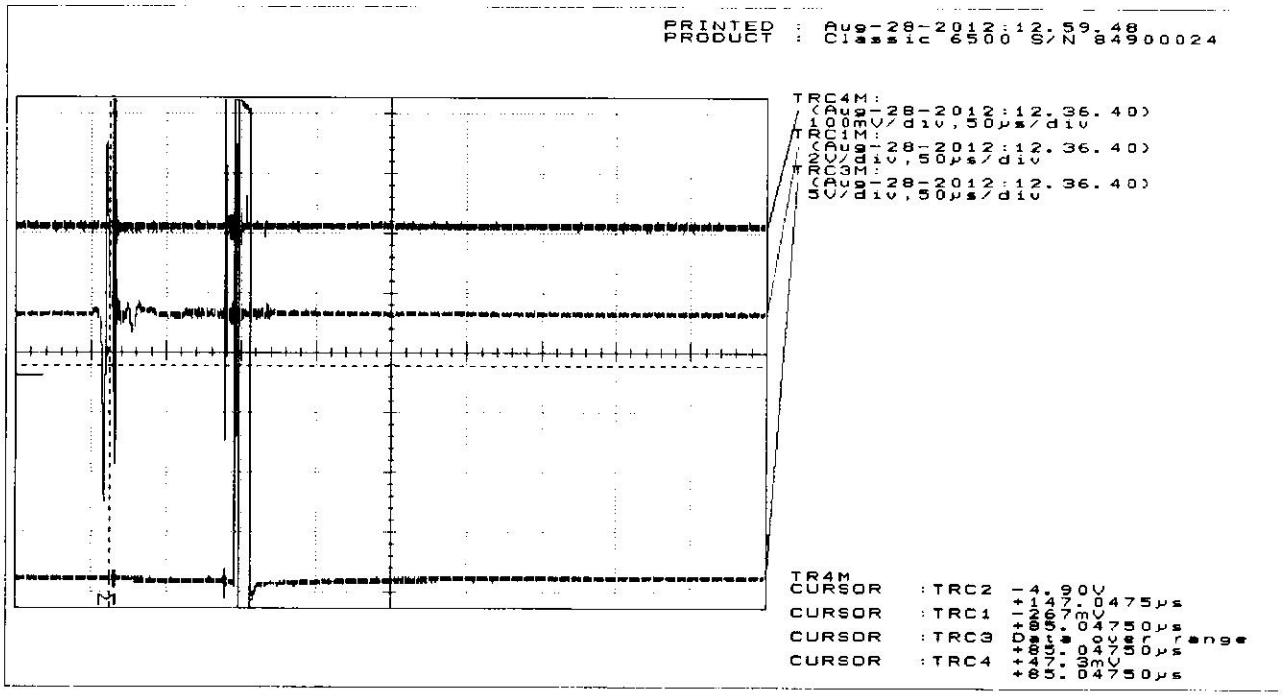
Note: The thickness of the reference zero point from the base is = **0.04265** Inches
1.08331 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00045	3.6	south
2	0.200	0.00025	3.40	
3	0.400	0.00015	3.20	
4	0.600	0.00010	3.00	
5	0.800	0.00010	2.80	
6	1.000	0.00000	2.60	
7	1.200	0.00000	2.40	
8	1.400	0.00000	2.20	
9	1.600	0.00000	2.00	
10	1.800	-0.00005	1.80	
11	2.000	0.00000	1.60	
12	2.200	0.00005	1.40	
13	2.400	0.00005	1.20	
14	2.600	0.00005	1.00	
15	2.800	0.00010	0.80	
16	3.000	0.00010	0.60	
17	3.200	0.00010	0.40	
18	3.400	0.00010	0.20	
19	3.600	0.00015	0.00	
20	3.800	0.00015	-0.20	
21	4.000	0.00010	-0.40	
22	4.200	0.00010	-0.60	
23	4.400	0.00010	-0.80	
24	4.600	0.00005	-1.00	
25	4.800	0.00005	-1.20	
26	5.000	-0.00005	-1.40	
27	5.200	-0.00005	-1.60	
28	5.400	-0.00010	-1.80	
29	5.600	-0.00010	-2.00	
30	5.800	-0.00010	-2.20	
31	6.000	0.00000	-2.40	
32	6.200	0.00010	-2.60	
33	6.400	0.00020	-2.80	
34	6.600	0.00025	-3.00	
35	6.800	0.00025	-3.20	
36	7.000	0.00035	-3.40	
37	7.200	0.00040	-3.60	north

470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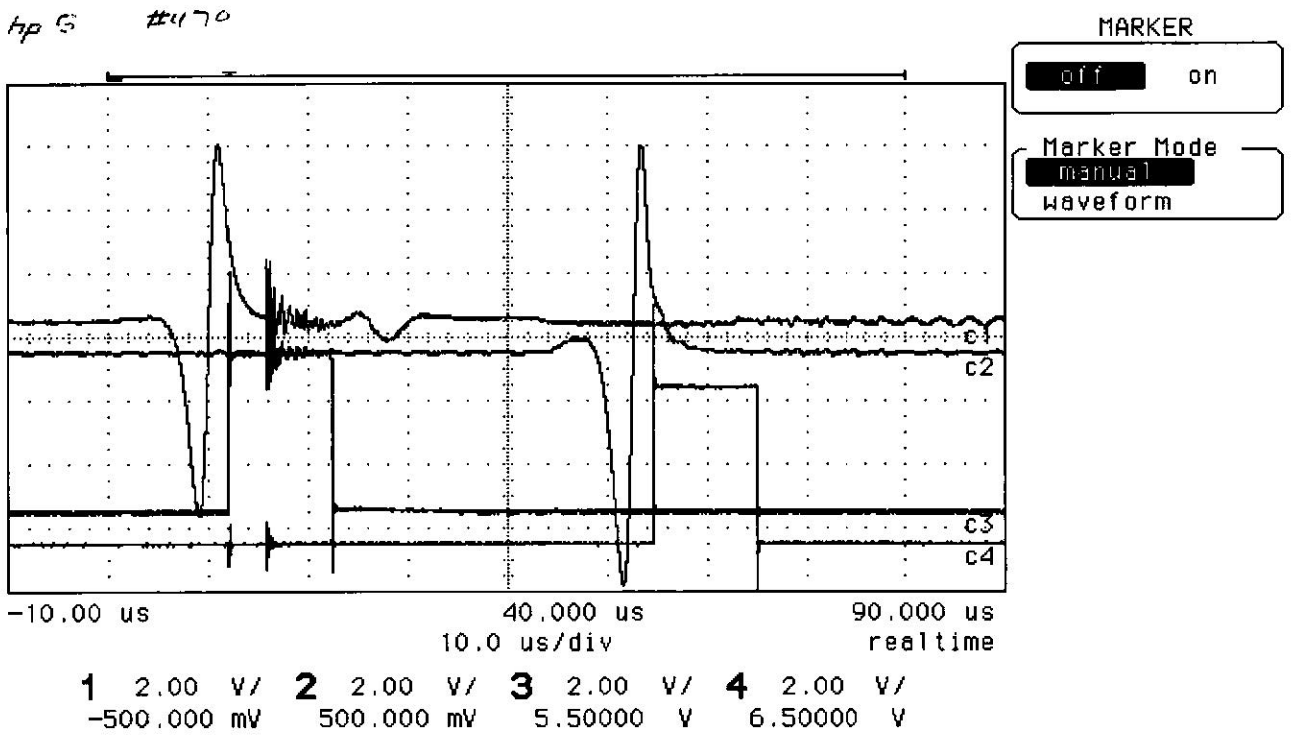
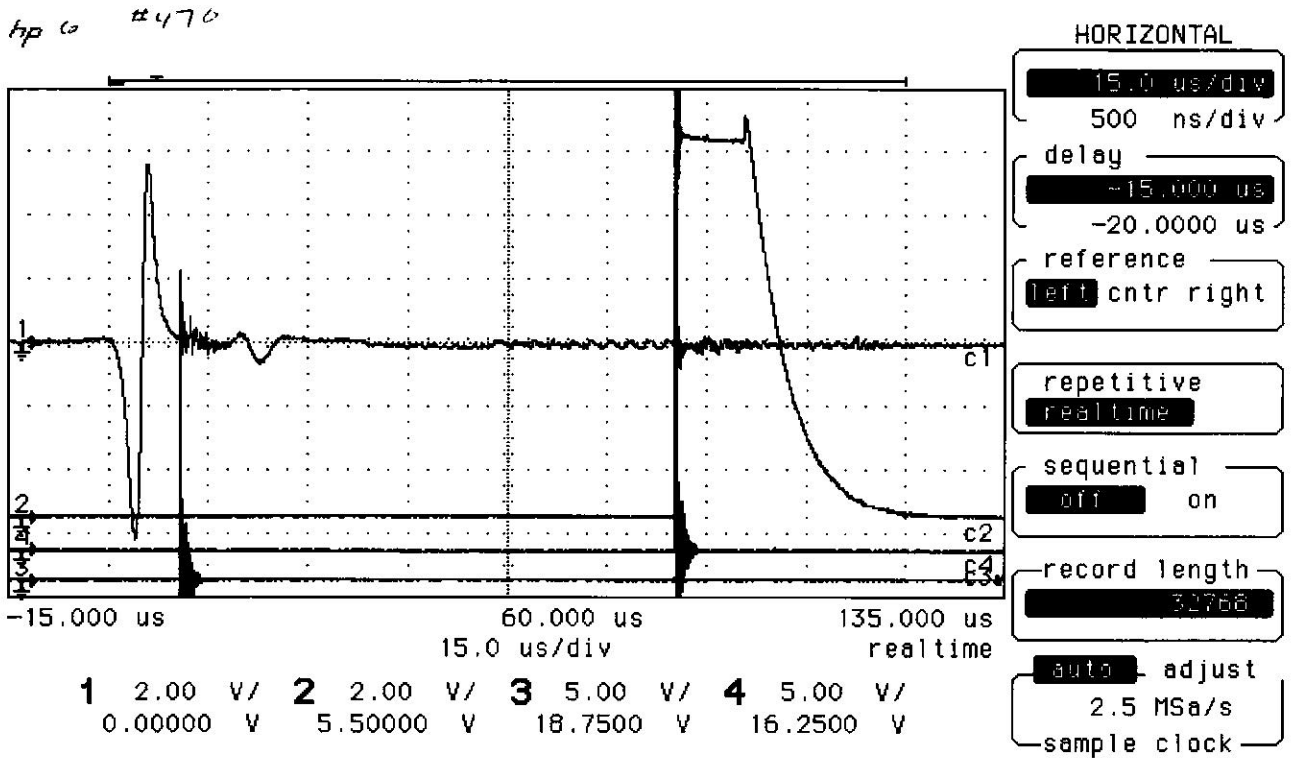
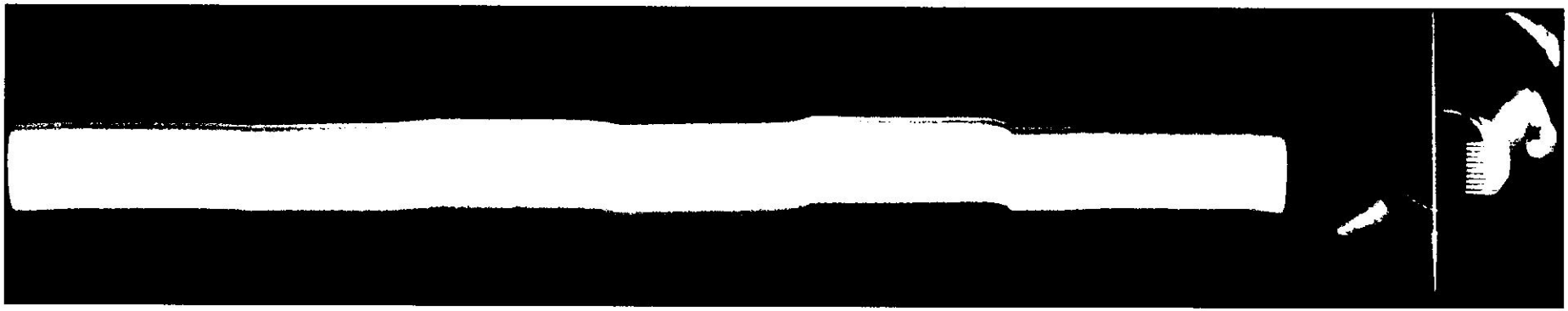
(Aug-28-2012:12.36.40)
100mV/div,50µs/div
TRC1M:
(Aug-28-2012:12.36.40)
2V/div,50µs/div
TRC3M:
(Aug-28-2012:12.36.40)
5V/div,50µs/div
TR4M
CURSOR :TRC2 -4.90V
+147.0475µs
CURSOR :TRC1 -267mV
+85.04750µs
CURSOR :TRC3 Delta over range
+85.04750µs
CURSOR :TRC4 +473mV
+85.04750µs


hp 5 #470
MARKER
off
on
Marker Mode
manual
waveform
c1
c2
c3
c4
-10.00 us
40.000 us
10.0 us/div
90.000 us
realtime
1 2.00 V/ -500.000 mV
2 2.00 V/ 500.000 mV
3 2.00 V/ 5.50000 V
4 2.00 V/ 6.50000 V


hp 6 #476
HORIZONTAL
15.0 us/div
500 ns/div
delay
-15.000 us
-20.0000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
2.5 MSa/s
sample clock
c1
c2
c4
c3
-15.000 us
60.000 us
15.0 us/div
135.000 us
realtime
1 2.00 V/ 0.00000 V
2 2.00 V/ 5.50000 V
3 5.00 V/ 18.7500 V
4 5.00 V/ 16.2500 V

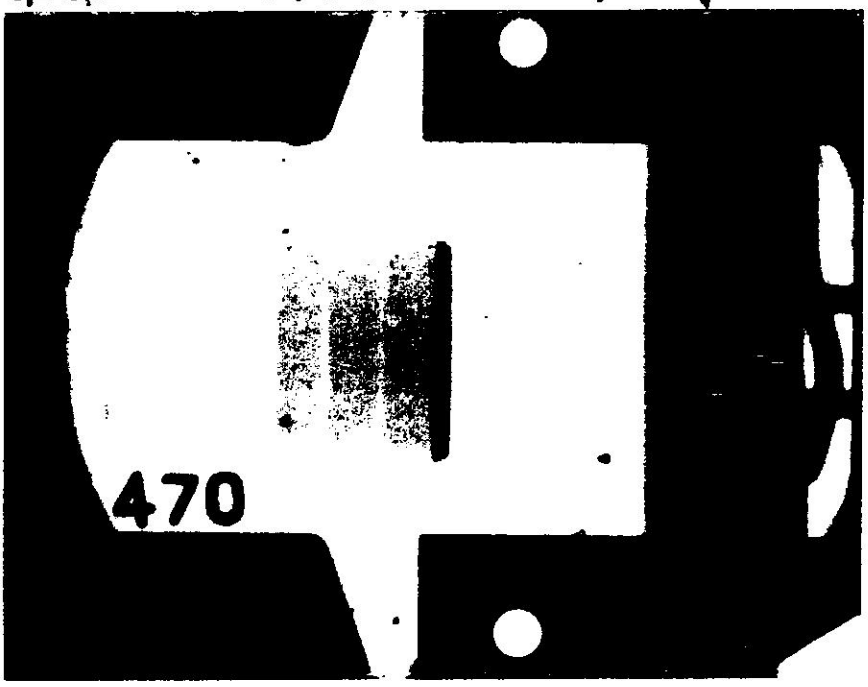
SHOT 470



LTO

8/28/2012 LGG shot #470 X-ray #1

8/28/2012 LGG shot #470 X-ray #2



LIGHT GAS GUN DATA SHEET

Shot No. 471 Date 9/5/12

Target:

Sample Material An-Hd (#33) Crystallographic orientation —

Source Location UMICH - R. Lange Thickness:1 — in.

Type of Measurement Pre-heated EOS 1400°C 2. — in.

Bulk Density — gm/cc Crystal Density — gm/cc

±2 std. devs. — gm/cc ±2 std. devs. — gm/cc

Total Shorting Pin Height — in. (shim to driver) Driver Plate Thickness 0.0411 in.

Material Mo

Projectile:

Weight 20.1235 gms. Length 0.908 in. Skirt Diameter 1.1130 in.

Flyer Plate Material Mo (#5) Leading Edge Dia. 1.1007 in.

Thickness 0.0602 in. Major Dia. 0.98438 in. Depth Inserted — in.

Minor Dia. 0.9870 in. Pressure 150 psi

Temp 21°C

Barrel Dimensions:

Breech Diameter — in. Muzzle Diameter — in. Taper — in.

Ellipticity @ projectile depth insertion point — in.

Piston:

Weight 6.6 lb. Length 20.5 in. O-ring Groove Depth 0.110 in.

Diameter: Front 3.496 in. Back 3.498 in.

Pump Tube:

Pre-Fill Pressure — in. Hg Fill Pressure — psig.

Powder Charge:

Main Charge 703 gms. Type IMR4350 Total Charge 715 gms.

Primer Charge 12 gms. Type IMR4350

Expected Velocity:

Projectile 5.70 km/sec Piston — km/sec

Notes:

pyrex windows - heated to 1415°C (1401°C)

L.G.G.

Camera Streak Duration: 1512 nsec Timing calibration frequency: 1478950/ MHz

Camera Writing Rate Dial Value: 198

Camera Slit Size: 25 µm Target to film magnification _____

Film Type: Flash X-ray: Polaroid Type 57

Xenon Trigger: Velocity Magnet #1

Delays: Flash X-ray #1 2.059 µsec Flash X-ray #2 64.014 µsec

Static Streak Photo _____ µsec.

Petal Valve:

Grove Depth: Total Thickness:

0.0553 in. min. 0.0938 in. min.

0.0548 in. max. 0.0940 in. max

Expected Burst Pressure 41K psi

Instrument Tank/Vacuum Pump Pressure: 103/108 µm

Distances:	Muzzle to Flash X-ray Marker #1	9.9 cm
	Flash X-ray Marker #1 to Flash X-ray Marker #2	35.32 cm
	Flash X-ray Marker #2 to Target	_____cm
	Velocity Magnet #1 to #2	20.34 cm
	Piston Velocity Gauge #1 to #2	30.48 cm
	Piston Velocity Gauge #2 to #3	30.48 cm

Piston Velocity from Gauge #1 to #2: _____ km/sec

Piston Velocity from Gauge #1 to #3: _____ km/sec

Projectile Velocity from UDC: _____ m/sec

Projectile Velocity from X-ray: _____ km/sec

Shot 471 Nominal Timeline Preshot

| | | |

COUNTER CONNECTIONS

	START SIGNAL	STOP SIGNAL		
Counter 1:	Piston Velocity Pin 1	Piston Velocity Pin 2	438	µsec
Counter 2:	Piston Velocity Pin 1	Piston Velocity Pin 3	879	µsec
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	35.1	µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	61.085	µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	67.158	µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	6.077	µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	61.072	µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	35.07	µsec
UDC Velocity:			5806.16	M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	160.60	ns
HP5, 2:	Velocity magnet 2	35.186	µsec
HP5, 3:	TTL Start	2.1414	µsec
HP5, 4:	TTL Stop	37.2151	µsec
HP6, 1:	Velocity Magnet 1	~~−1.86875~~ 96.60	ns ~~88~~
HP6,2:	Xenon Lamp Trigger	65.1697	µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	4.7991	µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	65.8708	µsec
GS7, 1:	Velocity Magnet 1	−1.86875	µsec
GS7,3:	Camera Trigger (UDC HV 1)	69.570	µsec
GS7, 4:	Camera Monitor Out	69.785	µsec

SHOT SIMULATION

COUNTER CONNECTIONS

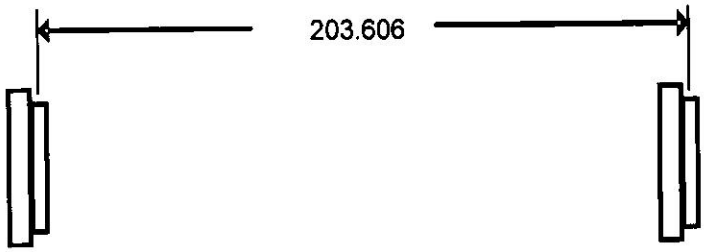
	START SIGNAL	STOP SIGNAL	
Counter 3:	Velocity Magnet #1	Velocity Magnet #2	35.400 µsec
Counter4:	X-ray 1 Delay Amp Mon. Out	X-ray 2 Delay Amp Mon. Out	62.124 µsec
Counter 5:	X-ray 1 Delay Amp Mon. Out	UDC HV 2 Pulse Out	67.756 µsec
Counter 6:	X-ray 2 Delay Amp Mon. Out	UDC HV 2 Pulse Out	5637 µsec
Counter 4: (Backup)	X-ray 1 Pulser Monitor Out	X-ray 2 Pulser Monitor Out	62.113 µsec
UDC Display:	Velocity Magnet 1	Velocity Magnet 2	35.370 µsec
UDC Velocity:			5755.73 M/sec

OSCILLOSCOPE CONNECTIONS

HP5, 1:	Velocity Magnet 1	~~468~~ 474 ns
HP5, 2:	Velocity magnet 2	35.8460 µsec
HP5, 3:	TTL Start	2.47960 µsec
HP5, 4:	TTL Stop	37.8348 µsec
HP6, 1:	Velocity Magnet 1	468 ns
HP6,2:	Xenon Lamp Trigger	66.0904 µsec
HP6, 3:	X-ray 1 Pulser Monitor Out	5.0986 µsec
HP6, 4:	X-ray 2 Pulser Monitor Out	67.21130 µsec
GS7, 1:	Velocity Magnet 1	−1.3885 µsec
GS7, 2:	Camera Cal. Sig.	71.2595 µsec
GS7,3:	Camera Trigger (UDC HV 1)	70.583 µsec
GS7, 4:	Camera Monitor Out	70.7950 µsec

MAGNET DISTANCE

Shot No. **471** Expected Velocity: **5.70**



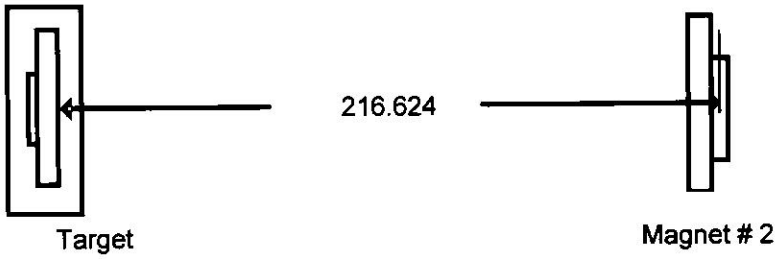
DISTANCE BETWEEN MAGNET # 1 TO MAGNET # 2

Mill Table Measurement = 8.016 inch

Distance Between Magnet # 1 to Magnet # 2 = 203.606 mm

TRAVEL TIME BETWEEN MAGNET # 1 TO MAGNET # 2 = **35.720 µsec.**

DISTANCE BETWEEN MAGNET # 2 TO TARGET



Micrometer Measurement

First measurement = 8.402 inch

Second measurement = 8.405 inch

Average measurement = 8.404 inch

Average measurement = 213.449 mm

Center line of the thickness of Magnet # 2 = 3.175 mm

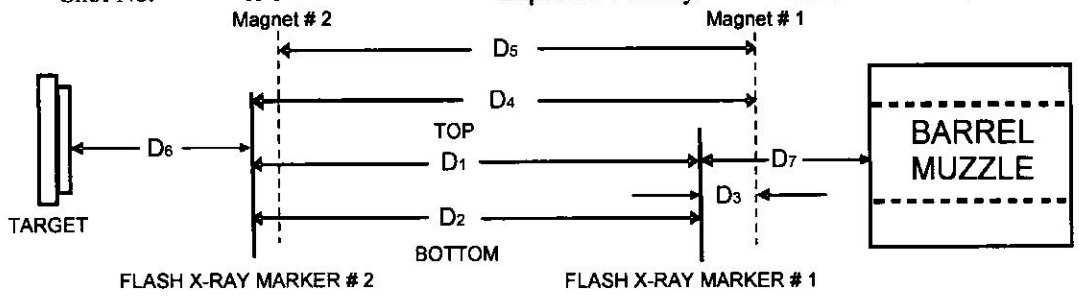
Distance Between Magnet # 2 to Target = 216.624 mm

TRAVEL TIME BETWEEN MAGNET # 2 TO TARGET = **38.004 µsec.**

Fudged Distance between Magnet 2 to Target = 202.954 mm

TARGET MEASUREMENT

Shot No. **471** Expected Velocity: **5.70** km/sec.



	D3, Magnet # 1 to Flash X-Ray Marker # 1	D4, Magnet # 1 to Flash X-Ray Marker # 2	D5, Magnet # 1 to Magnet # 2	D6, Target to Flash X-Ray Marker # 2	D7, Muzzle to Flash X-Ray Marker # 1
Measure # 1, mm	30.00	383.15	203.56	8.375	99.0
Measure # 2, mm	30.00	383.15	203.66	8.377	99.0
Average, mm	30.00	383.15	203.61	8.376	99.0
Travel time, µsec	**5.26**	**67.22**	**35.72**	**1.47**	**17.37**

Top

D1, Flash X-Ray fiducial distance 1: 353.19 mm
D1, Flash X-Ray fiducial distance 2: 353.24 mm
Average: 353.22 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**TOP**) : **61.97** µsec.

Bottom

D2, Flash X-Ray fiducial distance 1: 353.09 mm
D2, Flash X-Ray fiducial distance 2: 353.06 mm
Average: 353.08 mm

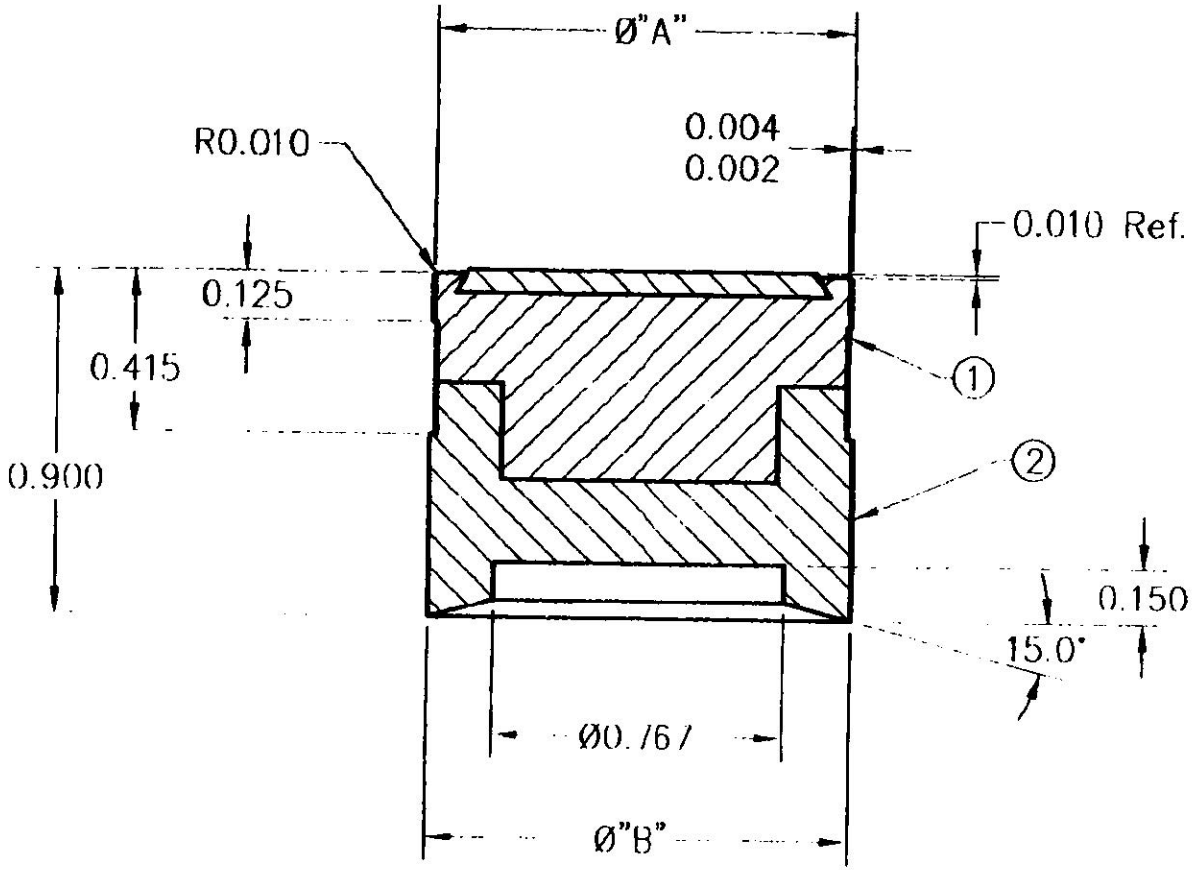
Average distance between D1 and D2: 353.145 mm

Time to travel from Flash X-Ray # 1 to Flash X-Ray # 2 (**BOTTOM**) : **61.94** µsec.

Flash X-Ray # 1 Delay (from Magnet # 1) **2.16** µsec.

Flash X-Ray # 2 Delay (from Magnet # 1) **64.57** µsec.

sheet values
2.059 ns
64.014 ns



Mo#5

20.1238 gms

SHOT#		
1.1007		
A	1.1007	+.0000 -.0005
1.1130		
B	1.1125	+.0005 -.0000

ITEM	NAME OF PART	DWG.	#REQ.
2	Gas Seal Blank	LGG-128	1
1	Sabot & Flyer Plate	LGG-157	1

Note: Super Glue & Press Fit 1 & 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN	DATE
M. Long	11/29/10
ENGINEER	DATE
APPROVED	DATE

MATERIAL: Zelux-M&HDP

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

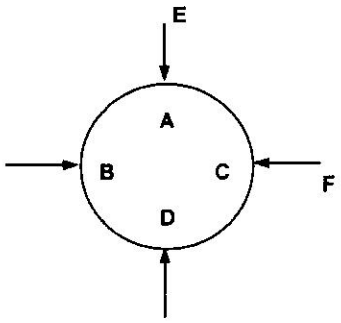
TITLE: Projectile Assy. for 28mm launch tube (GM)

SCALE	SHEET		DRAWING NUMBER
2:1	2 of 2	A	LGG-158

SHOT No. 471
LGG Moly Capsule Cap 11/18/2010
SAMPLE MATERIAL: Mo 33

Post polish

Thickness Measurement	
A	0.03010
A	0.03020
B	0.03030
B	0.03030
C	0.03035
C	0.03030
D	0.03025
D	0.03020



Diameter Measurement	
E	0.35350
E	0.35400
F	0.35350
F	0.35400
AVE	0.35375
Radius	0.1769

Statistic for thickness	
N	8
MAX	0.03035
MIN	0.0301
Range	0.00025
MEAN	0.03025
STDEV	8.01784E-05

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.35375
STDEV	0.000288675

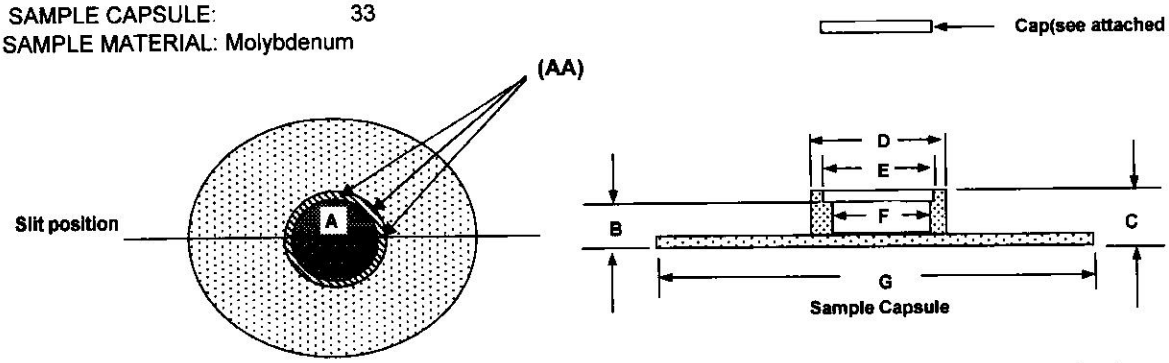
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03025	±	mm	
	FLATNESS:		0.00025			
	VOLUME:		0.0487		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.2065		$grams/cm^3$	

SHOT No.: 471 prepolish 11/18/2010

SAMPLE CAPSULE: 33

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04070
A	0.04095
A	0.04090
A	0.04090
Avg	0.04086

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17195
C	0.17190
C	0.17185
C	0.17195
D	0.3955
D	0.3955

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14155
B point 2	0.14155
B point 3	0.14155
B point 4	0.14150
B point 5	0.14150
B point 6	0.14155
B point 7	0.14160
B point 8	0.14160

Statistics

N	8
MAX	0.14160
MIN	0.14150
Range	0.00010
Average	0.14155

DIGITAL CALIFER DIAMETER MEASUREMENT

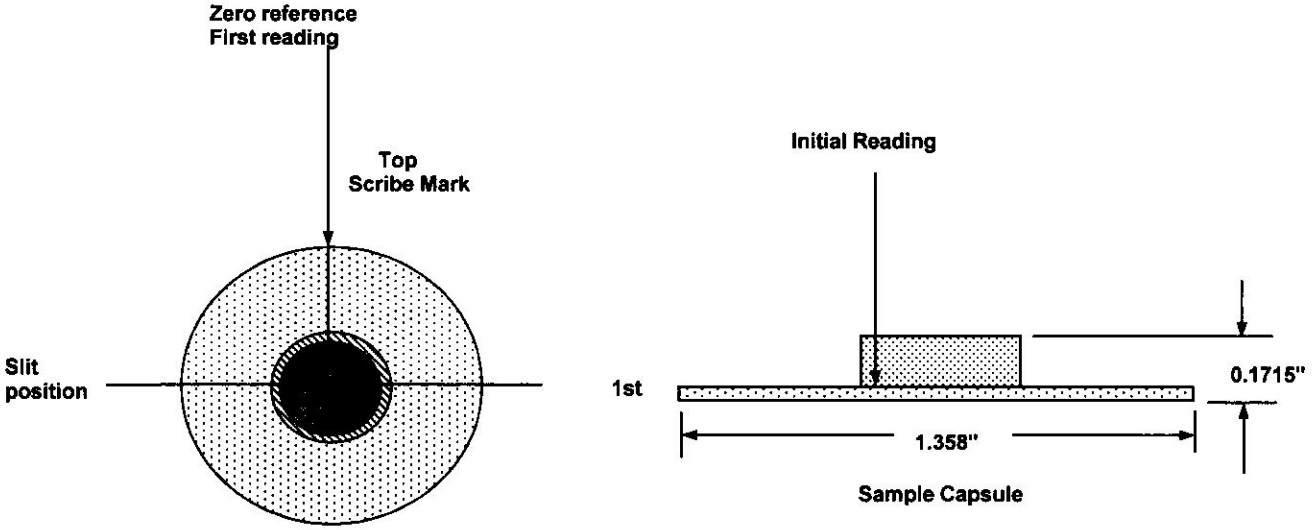
E	0.3540
E	0.3535
F	0.3145
F	0.3140
G	1.3590
G	1.3595
H	0.10069

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SAMPLE CAPSULE: **33**
SAMPLE MATERIAL: **Molybdenum**

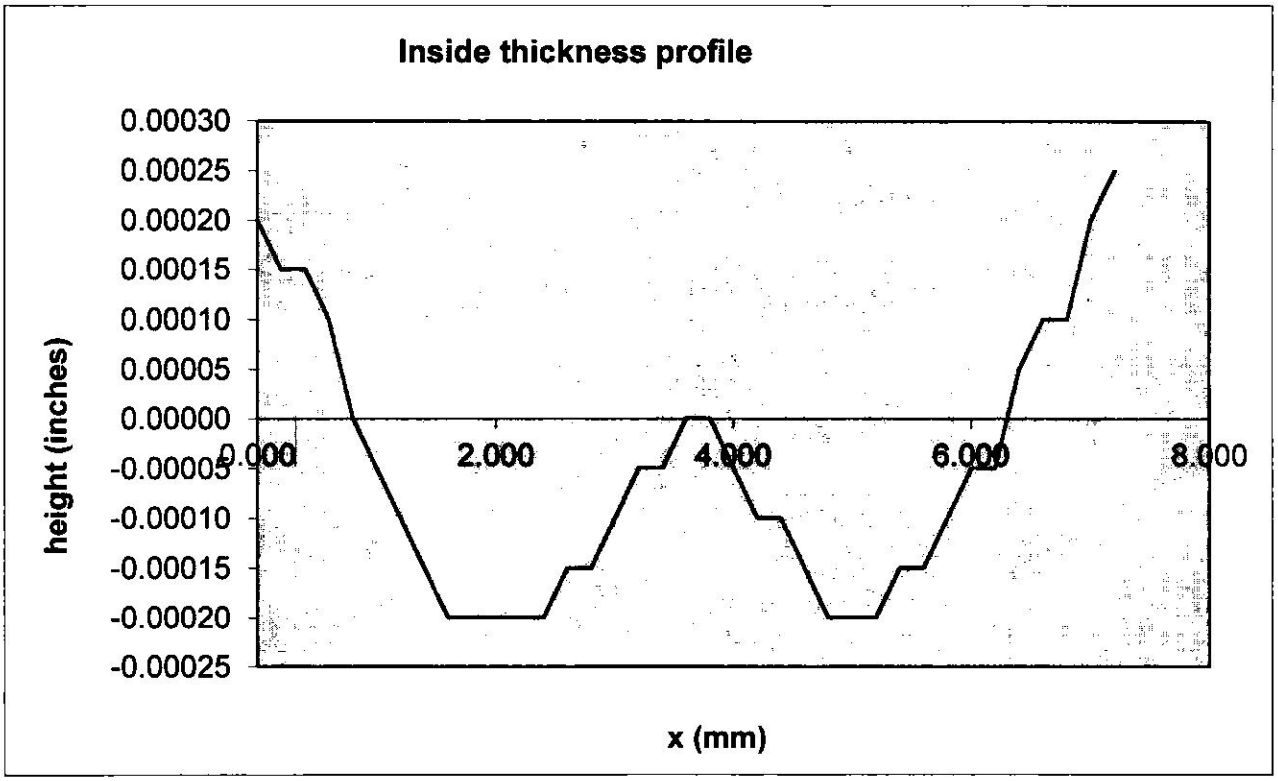
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.61
4.623



Average thickness reading = -0.00005

Note: The thickness of the reference zero point from the base is = **0.04215** Inches
1.07061 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00020	3.6	south
2	0.200	0.00015	3.40	
3	0.400	0.00015	3.20	
4	0.600	0.00010	3.00	
5	0.800	0.00000	2.80	
6	1.000	-0.00005	2.60	
7	1.200	-0.00010	2.40	
8	1.400	-0.00015	2.20	
9	1.600	-0.00020	2.00	
10	1.800	-0.00020	1.80	
11	2.000	-0.00020	1.60	
12	2.200	-0.00020	1.40	
13	2.400	-0.00020	1.20	
14	2.600	-0.00015	1.00	
15	2.800	-0.00015	0.80	
16	3.000	-0.00010	0.60	
17	3.200	-0.00005	0.40	
18	3.400	-0.00005	0.20	
19	3.600	0.00000	0.00	
20	3.800	0.00000	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00010	-0.60	
23	4.400	-0.00010	-0.80	
24	4.600	-0.00015	-1.00	
25	4.800	-0.00020	-1.20	
26	5.000	-0.00020	-1.40	
27	5.200	-0.00020	-1.60	
28	5.400	-0.00015	-1.80	
29	5.600	-0.00015	-2.00	
30	5.800	-0.00010	-2.20	
31	6.000	-0.00005	-2.40	
32	6.200	-0.00005	-2.60	
33	6.400	0.00005	-2.80	
34	6.600	0.00010	-3.00	
35	6.800	0.00010	-3.20	
36	7.000	0.00020	-3.40	
37	7.200	0.00025	-3.60	north

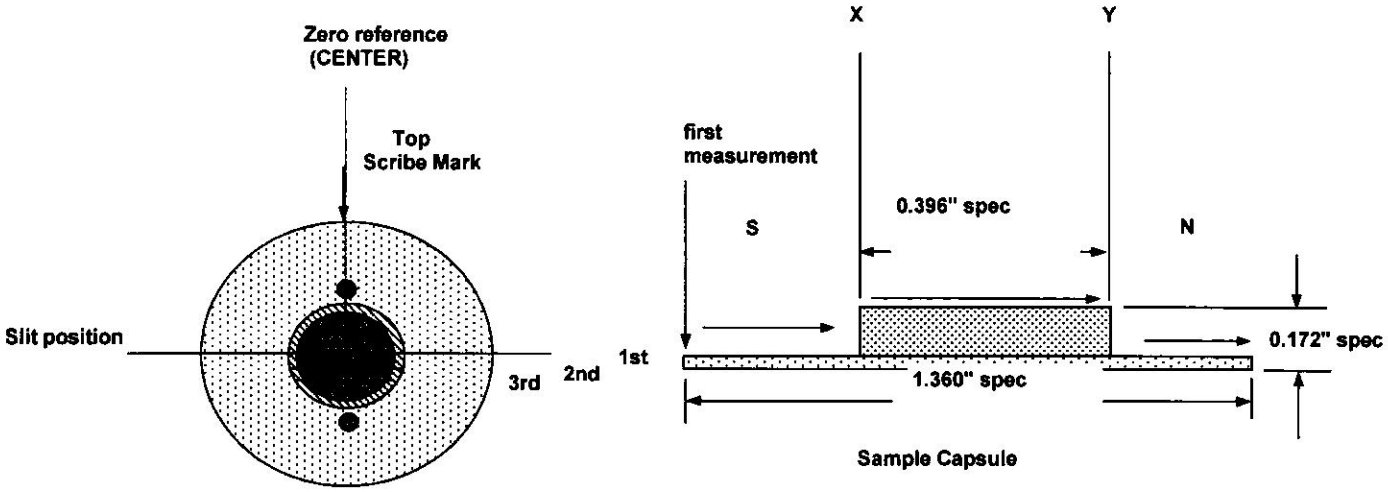
SHOT No. _ 471 tip used: .7mm long/ flat tip

SAMPLE CAPSULE: 33

SAMPLE MATERIAL: An-Hd 5.3675

direction of measurement

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

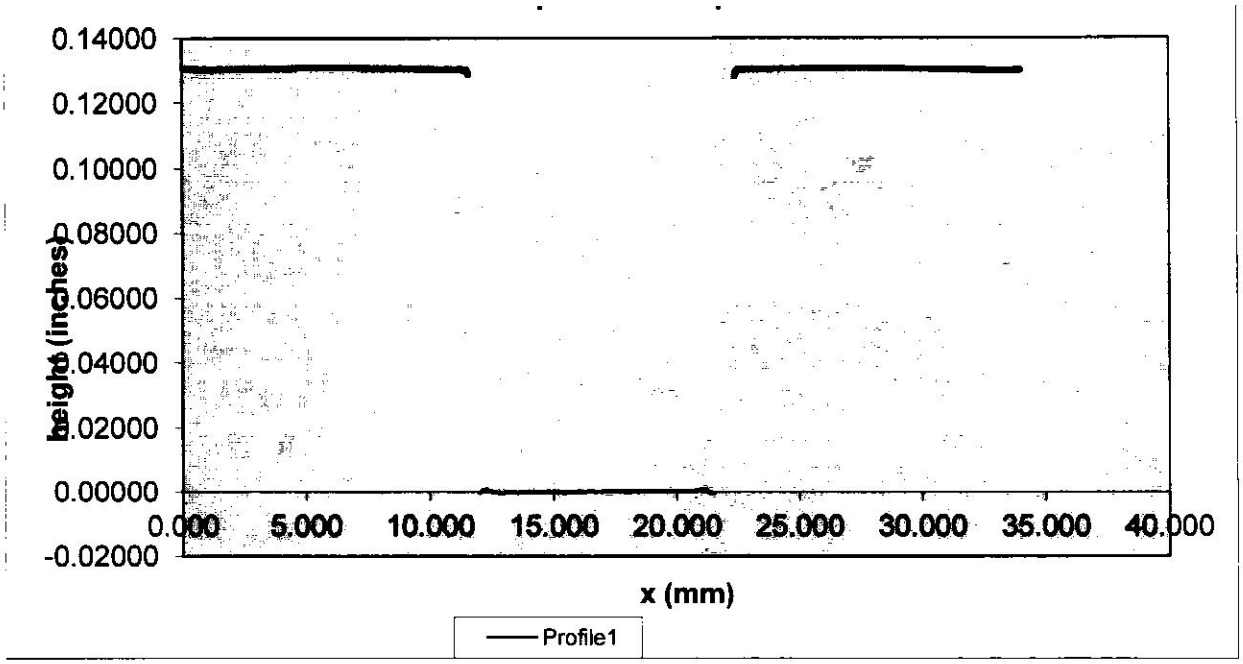
Average thickness reading = 0.00001

Note: Measurement from reference zero point from the base is = **-0.1716** Inches
-4.3574 mm

Average thickness of the driver Plate = -0.0411 Inches
-1.0451 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
height (inches)
0.000
5.000
10.000
15.000
20.000
25.000
30.000
35.000
40.000
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment

# reading	dist(mm)	absdist(mm)	South (left side)	# reading	dist(mm)	absdist(mm)	North (right s
1	0.000	17.000	0.1308	225	22.400	-5.400	0.1279
2	0.100	16.900	0.1306	226	22.500	-5.500	0.1302
3	0.200	16.800	0.1306	227	22.600	-5.600	0.1302
4	0.300	16.700	0.1306	228	22.700	-5.700	0.1302
5	0.400	16.600	0.1305	229	22.800	-5.800	0.1302
6	0.500	16.500	0.1304	230	22.900	-5.900	0.1302
7	0.600	16.400	0.1304	231	23.000	-6.000	0.1302
8	0.700	16.300	0.1304	232	23.100	-6.100	0.1302
9	0.800	16.200	0.1304	233	23.200	-6.200	0.1302
10	0.900	16.100	0.1304	234	23.300	-6.300	0.1302
11	1.000	16.000	0.1304	235	23.400	-6.400	0.1302
12	1.100	15.900	0.1304	236	23.500	-6.500	0.1302
13	1.200	15.800	0.1304	237	23.600	-6.600	0.1303
14	1.300	15.700	0.1304	238	23.700	-6.700	0.1303
15	1.400	15.600	0.1304	239	23.800	-6.800	0.1303
16	1.500	15.500	0.1304	240	23.900	-6.900	0.1303
17	1.600	15.400	0.1304	241	24.000	-7.000	0.1303
18	1.700	15.300	0.1304	242	24.100	-7.100	0.1303
19	1.800	15.200	0.1305	243	24.200	-7.200	0.1303
20	1.900	15.100	0.1305	244	24.300	-7.300	0.1303
21	2.000	15.000	0.1305	245	24.400	-7.400	0.1303
22	2.100	14.900	0.1305	246	24.500	-7.500	0.1303
23	2.200	14.800	0.1305	247	24.600	-7.600	0.1303
24	2.300	14.700	0.1305	248	24.700	-7.700	0.1304
25	2.400	14.600	0.1305	249	24.800	-7.800	0.1304
26	2.500	14.500	0.1305	250	24.900	-7.900	0.1304
27	2.600	14.400	0.1306	251	25.000	-8.000	0.1304
28	2.700	14.300	0.1306	252	25.100	-8.100	0.1304
29	2.800	14.200	0.1306	253	25.200	-8.200	0.1304
30	2.900	14.100	0.1306	254	25.300	-8.300	0.1304
31	3.000	14.000	0.1306	255	25.400	-8.400	0.1305
32	3.100	13.900	0.1306	256	25.500	-8.500	0.1304
33	3.200	13.800	0.1307	257	25.600	-8.600	0.1304
34	3.300	13.700	0.1307	258	25.700	-8.700	0.1305
35	3.400	13.600	0.1307	259	25.800	-8.800	0.1305
36	3.500	13.500	0.1307	260	25.900	-8.900	0.1305
37	3.600	13.400	0.1307	261	26.000	-9.000	0.1305
38	3.700	13.300	0.1307	262	26.100	-9.100	0.1305
39	3.800	13.200	0.1307	263	26.200	-9.200	0.1305
40	3.900	13.100	0.1307	264	26.300	-9.300	0.1305
41	4.000	13.000	0.1308	265	26.400	-9.400	0.1305
42	4.100	12.900	0.1308	266	26.500	-9.500	0.1305
43	4.200	12.800	0.1308	267	26.600	-9.600	0.1305
44	4.300	12.700	0.1308	268	26.700	-9.700	0.1305
45	4.400	12.600	0.1308	269	26.800	-9.800	0.1306
46	4.500	12.500	0.1308	270	26.900	-9.900	0.1305
47	4.600	12.400	0.1308	271	27.000	-10.000	0.1305
48	4.700	12.300	0.1308	272	27.100	-10.100	0.1305
49	4.800	12.200	0.1308	273	27.200	-10.200	0.1305
50	4.900	12.100	0.1308	274	27.300	-10.300	0.1305
51	5.000	12.000	0.1308	275	27.400	-10.400	0.1305
52	5.100	11.900	0.1308	276	27.500	-10.500	0.1305
53	5.200	11.800	0.1308	277	27.600	-10.600	0.1306
54	5.300	11.700	0.1308	278	27.700	-10.700	0.1305
55	5.400	11.600	0.1308	279	27.800	-10.800	0.1305
56	5.500	11.500	0.1309	280	27.900	-10.900	0.1306
57	5.600	11.400	0.1308	281	28.000	-11.000	0.1305
58	5.700	11.300	0.1308	282	28.100	-11.100	0.1305
59	5.800	11.200	0.1309	283	28.200	-11.200	0.1305

60	5.900	11.100	0.1309	284	28.300	-11.300	0.1305
61	6.000	11.000	0.1309	285	28.400	-11.400	0.1305
62	6.100	10.900	0.1309	286	28.500	-11.500	0.1305
63	6.200	10.800	0.1309	287	28.600	-11.600	0.1305
64	6.300	10.700	0.1309	288	28.700	-11.700	0.1305
65	6.400	10.600	0.1309	289	28.800	-11.800	0.1305
66	6.500	10.500	0.1309	290	28.900	-11.900	0.1304
67	6.600	10.400	0.1309	291	29.000	-12.000	0.1305
68	6.700	10.300	0.1309	292	29.100	-12.100	0.1304
69	6.800	10.200	0.1309	293	29.200	-12.200	0.1305
70	6.900	10.100	0.1309	294	29.300	-12.300	0.1305
71	7.000	10.000	0.1308	295	29.400	-12.400	0.1304
72	7.100	9.900	0.1308	296	29.500	-12.500	0.1304
73	7.200	9.800	0.1308	297	29.600	-12.600	0.1304
74	7.300	9.700	0.1308	298	29.700	-12.700	0.1304
75	7.400	9.600	0.1308	299	29.800	-12.800	0.1304
76	7.500	9.500	0.1308	300	29.900	-12.900	0.1304
77	7.600	9.400	0.1308	301	30.000	-13.000	0.1303
78	7.700	9.300	0.1308	302	30.100	-13.100	0.1303
79	7.800	9.200	0.1308	303	30.200	-13.200	0.1303
80	7.900	9.100	0.1307	304	30.300	-13.300	0.1303
81	8.000	9.000	0.1307	305	30.400	-13.400	0.1303
82	8.100	8.900	0.1307	306	30.500	-13.500	0.1302
83	8.200	8.800	0.1307	307	30.600	-13.600	0.1302
84	8.300	8.700	0.1307	308	30.700	-13.700	0.1302
85	8.400	8.600	0.1306	309	30.800	-13.800	0.1302
86	8.500	8.500	0.1307	310	30.900	-13.900	0.1302
87	8.600	8.400	0.1307	311	31.000	-14.000	0.1302
88	8.700	8.300	0.1306	312	31.100	-14.100	0.1301
89	8.800	8.200	0.1306	313	31.200	-14.200	0.1301
90	8.900	8.100	0.1306	314	31.300	-14.300	0.1301
91	9.000	8.000	0.1306	315	31.400	-14.400	0.1301
92	9.100	7.900	0.1306	316	31.500	-14.500	0.1301
93	9.200	7.800	0.1306	317	31.600	-14.600	0.1300
94	9.300	7.700	0.1305	318	31.700	-14.700	0.1301
95	9.400	7.600	0.1305	319	31.800	-14.800	0.1300
96	9.500	7.500	0.1305	320	31.900	-14.900	0.1300
97	9.600	7.400	0.1305	321	32.000	-15.000	0.1300
98	9.700	7.300	0.1305	322	32.100	-15.100	0.1300
99	9.800	7.200	0.1305	323	32.200	-15.200	0.1300
100	9.900	7.100	0.1305	324	32.300	-15.300	0.1300
101	10.000	7.000	0.1305	325	32.400	-15.400	0.1299
102	10.100	6.900	0.1304	326	32.500	-15.500	0.1299
103	10.200	6.800	0.1304	327	32.600	-15.600	0.1299
104	10.300	6.700	0.1304	328	32.700	-15.700	0.1299
105	10.400	6.600	0.1304	329	32.800	-15.800	0.1299
106	10.500	6.500	0.1304	330	32.900	-15.900	0.1299
107	10.600	6.400	0.1303	331	33.000	-16.000	0.1299
108	10.700	6.300	0.1303	332	33.100	-16.100	0.1299
109	10.800	6.200	0.1303	333	33.200	-16.200	0.1298
110	10.900	6.100	0.1303	334	33.300	-16.300	0.1299
111	11.000	6.000	0.1303	335	33.400	-16.400	0.1298
112	11.100	5.900	0.1303	336	33.500	-16.500	0.1298
113	11.200	5.800	0.1303	337	33.600	-16.600	0.1298
114	11.300	5.700	0.1303	338	33.700	-16.700	0.1299
115	11.400	5.600	0.1303	339	33.800	-16.800	0.1299
116	11.500	5.500	0.1303	340	33.900	-16.900	0.1299
117	11.600	5.400	0.1288	341	34.000	-17.000	0.1300

# reading	dist(mm)	absdist(mm	1st	2nd	3 rd
118	11.700	5.300	Run	Run	Run
119	11.800	5.200	Reading	Reading	Reading
120	11.900	5.100	Inches	Inches	Inches
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	-0.00020		
125	12.400	4.600	0.00020		
126	12.500	4.500	0.00055		
127	12.600	4.400	0.00080		
128	12.700	4.300	0.00030		
129	12.800	4.200	0.00000		
130	12.900	4.100	-0.00015		
131	13.000	4.000	-0.00020		
132	13.100	3.900	-0.00020		
133	13.200	3.800	-0.00020		
134	13.300	3.700	-0.00020		
135	13.400	3.600	-0.00015		
136	13.500	3.500	-0.00020		
137	13.600	3.400	-0.00020		
138	13.700	3.300	-0.00020		
139	13.800	3.200	-0.00020		
140	13.900	3.100	-0.00020		
141	14.000	3.000	-0.00015		
142	14.100	2.900	-0.00010		
143	14.200	2.800	-0.00010		
144	14.300	2.700	-0.00015		
145	14.400	2.600	-0.00015		
146	14.500	2.500	-0.00015		
147	14.600	2.400	-0.00010		
148	14.700	2.300	-0.00010		
149	14.800	2.200	-0.00015		
150	14.900	2.100	-0.00010		
151	15.000	2.000	-0.00010		
152	15.100	1.900	-0.00010		
153	15.200	1.800	-0.00010		
154	15.300	1.700	-0.00005		
155	15.400	1.600	-0.00010		
156	15.500	1.500	-0.00010		
157	15.600	1.400	-0.00010		
158	15.700	1.300	-0.00010		
159	15.800	1.200	-0.00005		
160	15.900	1.100	-0.00005		
161	16.000	1.000	-0.00005		
162	16.100	0.900	-0.00005		
163	16.200	0.800	-0.00005		
164	16.300	0.700	0.00000		
165	16.400	0.600	-0.00005		
166	16.500	0.500	0.00000		
167	16.600	0.400	0.00000		
168	16.700	0.300	0.00005		
169	16.800	0.200	0.00005		
170	16.900	0.100	0.00005		
171	17.000	0.000	0.00000		
172	17.100	-0.100	0.00000		
173	17.200	-0.200	0.00000		
174	17.300	-0.300	0.00000		
175	17.400	-0.400	0.00005		
176	17.500	-0.500	0.00005		

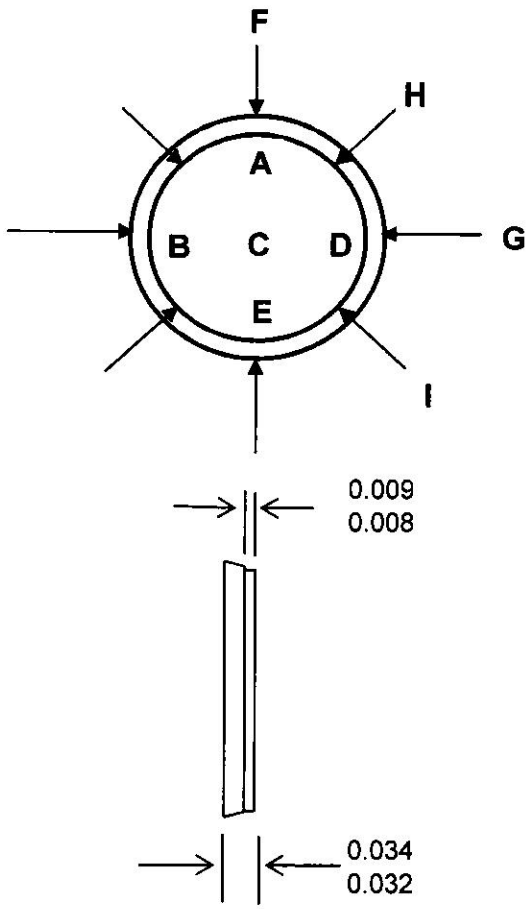
177	17.600	-0.600	0.00005		
178	17.700	-0.700	0.00005		
179	17.800	-0.800	0.00005		
180	17.900	-0.900	0.00005		
181	18.000	-1.000	0.00005		
182	18.100	-1.100	0.00005		
183	18.200	-1.200	0.00005		
184	18.300	-1.300	0.00005		
185	18.400	-1.400	0.00000		
186	18.500	-1.500	0.00000		
187	18.600	-1.600	0.00005		
188	18.700	-1.700	0.00005		
189	18.800	-1.800	0.00005		
190	18.900	-1.900	0.00005		
191	19.000	-2.000	0.00005		
192	19.100	-2.100	0.00005		
193	19.200	-2.200	0.00005		
194	19.300	-2.300	0.00005		
195	19.400	-2.400	0.00005		
196	19.500	-2.500	0.00005		
197	19.600	-2.600	0.00005		
198	19.700	-2.700	0.00005		
199	19.800	-2.800	0.00005		
200	19.900	-2.900	0.00005		
201	20.000	-3.000	0.00005		
202	20.100	-3.100	0.00005		
203	20.200	-3.200	0.00005		
204	20.300	-3.300	0.00005		
205	20.400	-3.400	0.00005		
206	20.500	-3.500	0.00005		
207	20.600	-3.600	0.00010		
208	20.700	-3.700	0.00010		
209	20.800	-3.800	0.00010		
210	20.900	-3.900	0.00010		
211	21.000	-4.000	0.00010		
212	21.100	-4.100	0.00015		
213	21.200	-4.200	0.00025		
214	21.300	-4.300	0.00065		
215	21.400	-4.400	0.00095		
216	21.500	-4.500	0.00055		
217	21.600	-4.600	-0.00020		
218	21.700	-4.700	-0.00045		
219	21.800	-4.800	-0.00055		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

SHOT No. **471**

FLYER PLATE MATERIAL: **Mo 5** 7/5/2012

Measurement done by: Emma

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.06015	F	0.98450
A	0.06030	F	0.98450
B	0.06030	G	0.98450
B	0.06025	G	0.98400
C	0.06030	H	0.92700
C	0.06030	H	0.92700
D	0.06020	I	0.92700
D	0.06015	I	0.92700
E	0.06005		
E	0.06010		



Statistic for thickness

N	10
MAX	0.06030
MIN	0.06005
Range	0.00025
MEAN	0.06021
	1.529334 mm
STDEV	9.36898E-05

Statistic for Diameter (F-G)

N	4
MAX	0.98450
MIN	0.98400
Range	0.00050
MEAN	0.9843750 inch
	25.0031250 mm
STDEV	0.00025

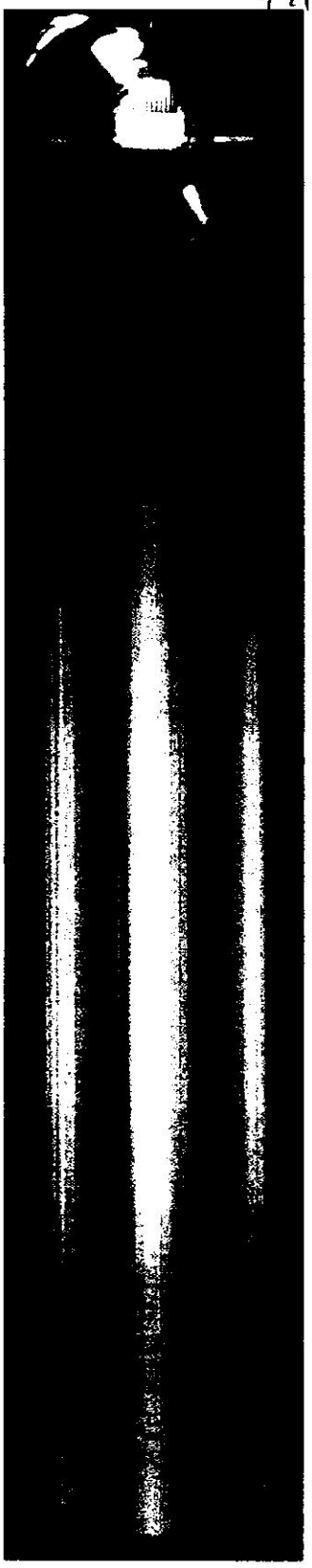
Statistic for Diameter (H-I)

N	4
MAX	0.92700
MIN	0.92700
Range	0.00000
MEAN	0.927 inch
	23.5458 mm
STDEV	0

	Sample in Air	Crystal Density	
1	7.13054	10.22	
2	7.13065	10.22	
3	7.13098	10.21	

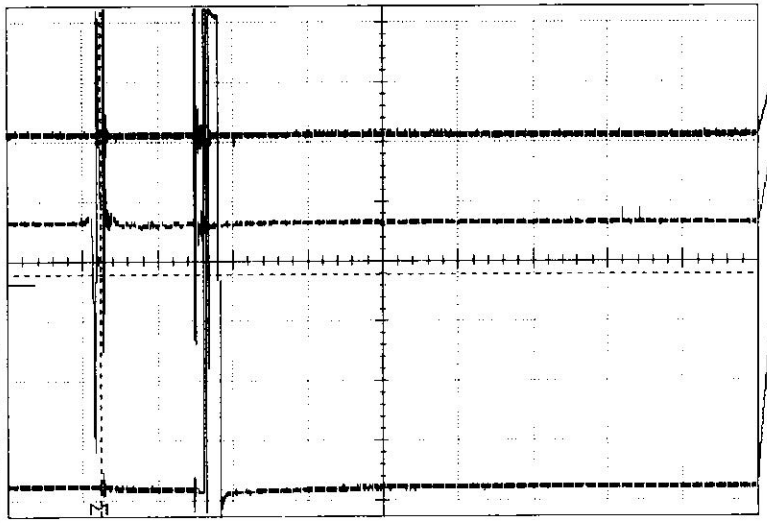
Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.06021	±	in
FLATNESS:	0.00025	in.	
VOLUME:			cm^3
CRYSTAL DENSITY:	10.2150		$grams/cm^3$
BULK DENSITY:	#DIV/0!		$grams/cm^3$
DENSITIES CHECKED BY: _____ on _____			
MEASUREMENT CHECKED B	Emma	7/5/2012	



GS-7 471

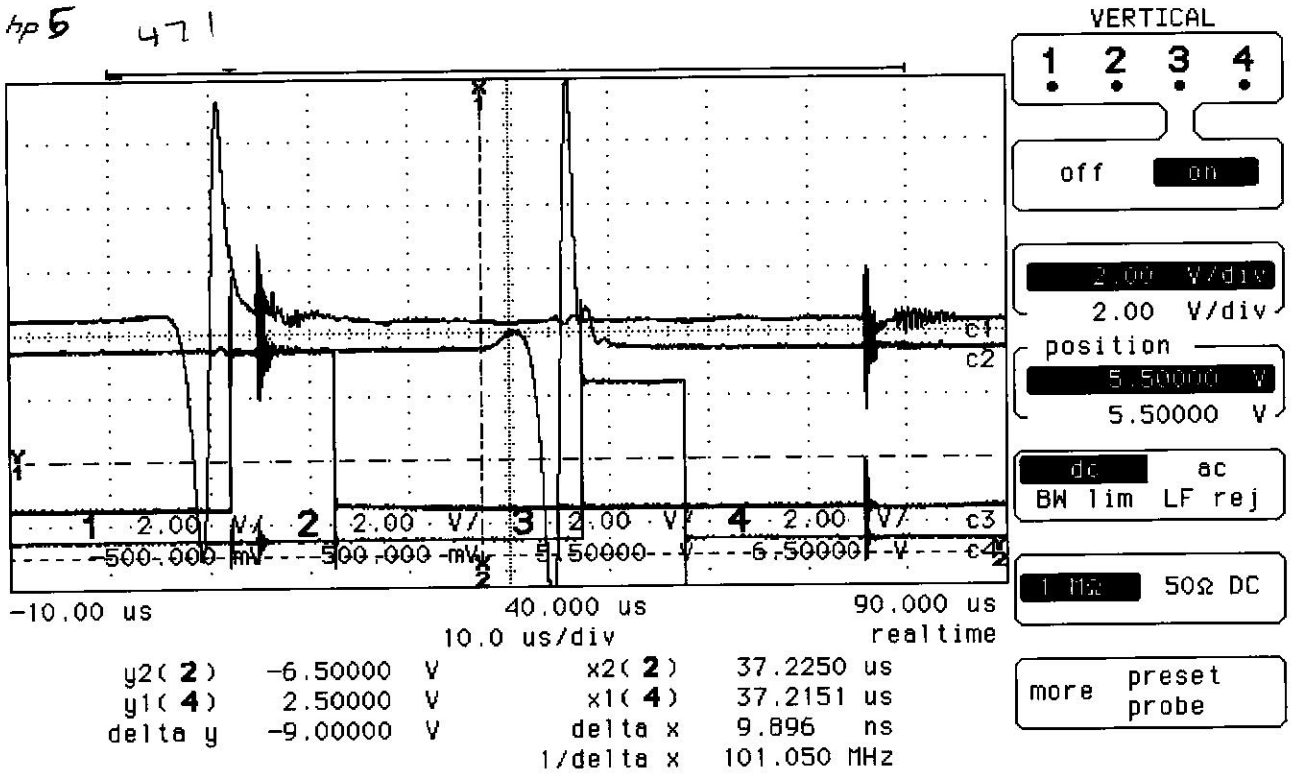
PRINTED : Sep-5-2012:15.53.54
PRODUCT : Classic 6500 S/N 84900024



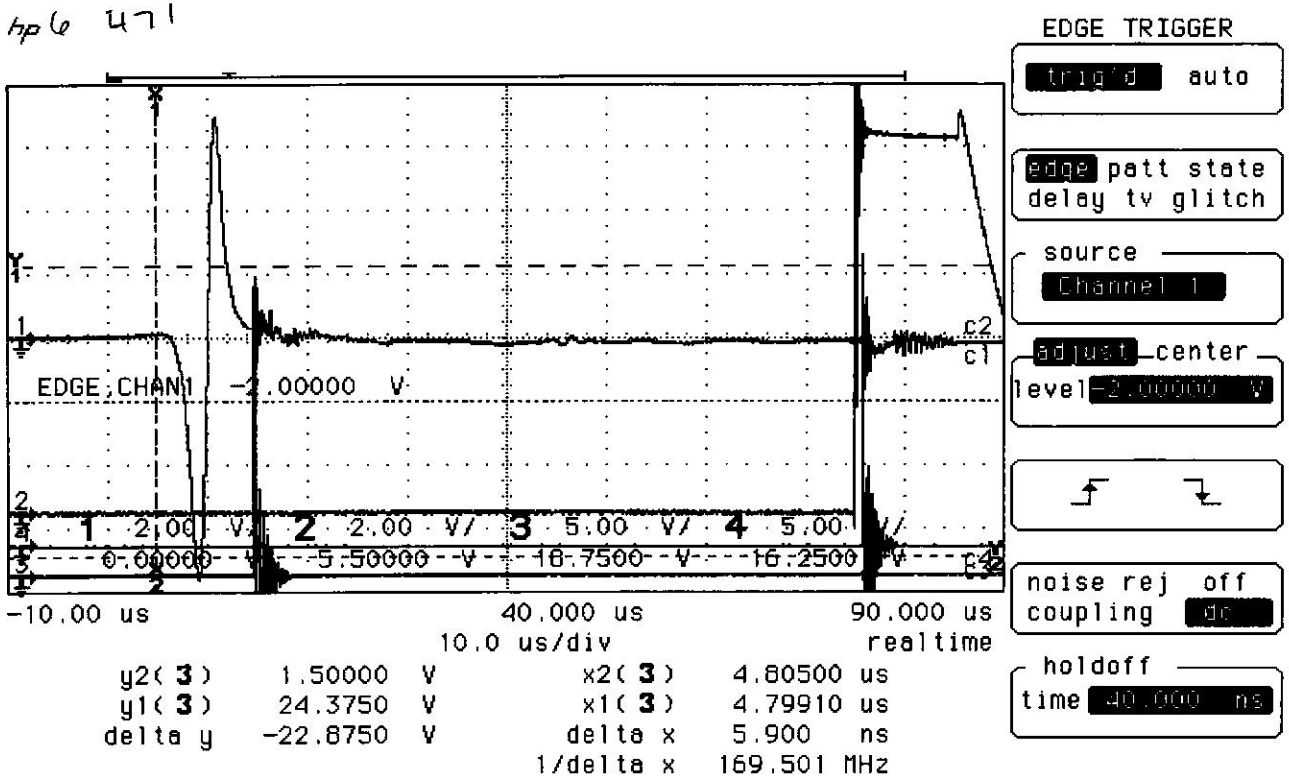
TRC4M:
(Sep-5-2012:15.34.22)
100mV/div,50µs/div
TRC1M:
(Sep-5-2012:15.34.22)
2V/div,50µs/div
TRC3M:
(Sep-5-2012:15.34.22)
5V/div,50µs/div

TR4M
CURSOR :TRC2 -4.90V
+131.7850µs
CURSOR :TRC1 -467mV
+69.78500µs
CURSOR :TRC3 Data over range
+69.78500µs
CURSOR :TRC4 +30.7mV
+69.78500µs

hp5 471

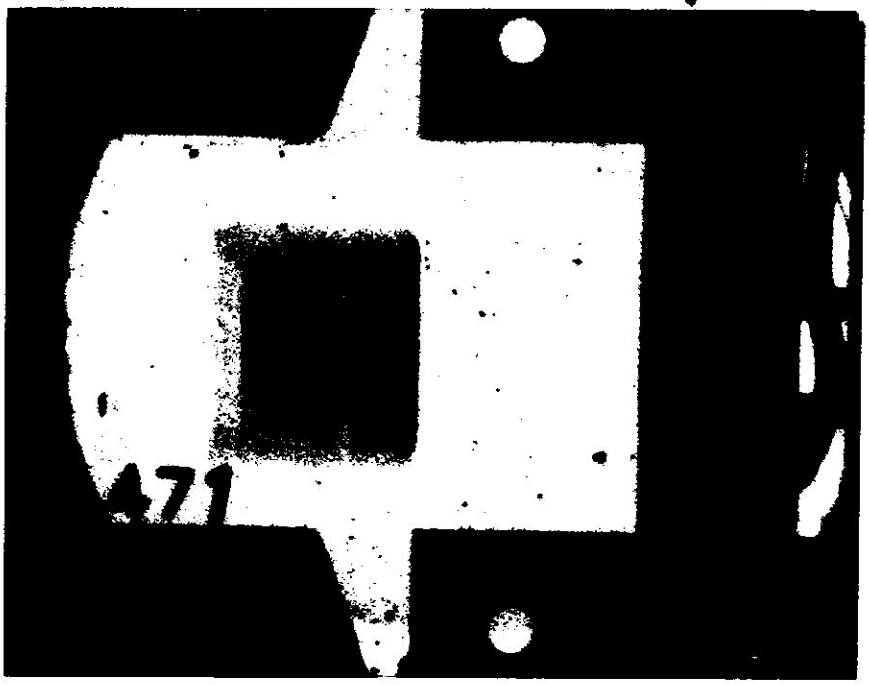

VERTICAL
1 2 3 4
off on
2.00 V/div
2.00 V/div
position
5.50000 V
5.50000 V
dc ac
BW lim LF rej
1 MΩ 50Ω DC
more preset probe
c1
c2
c3
c4
1 2.00 V/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/
-500.000 mV -500.000 mV -5.50000 V -6.50000 V
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(2) -6.50000 V
y1(4) 2.50000 V
delta y -9.00000 V
x2(2) 37.2250 us
x1(4) 37.2151 us
delta x 9.896 ns
1/delta x 101.050 MHz

hp 6 471

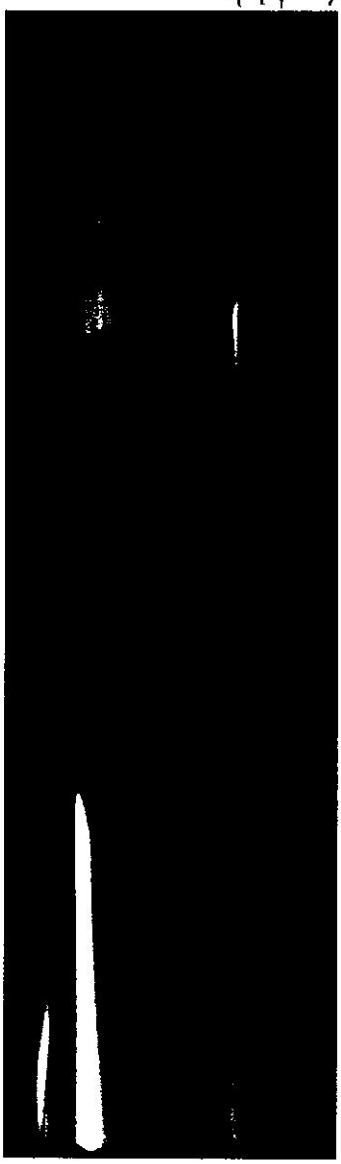

EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 1
adjust center
level -2.00000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
EDGE,CHAN1 -2.00000 V
c2
c1
1 2.00 V/ 2 2.00 V/ 3 5.00 V/ 4 5.00 V/
0.00000 V -5.50000 V 16.7500 V 16.2500 V
-10.00 us
40.000 us
90.000 us
10.0 us/div
realtime
y2(3) 1.50000 V
y1(3) 24.3750 V
delta y -22.8750 V
x2(3) 4.80500 us
x1(3) 4.79910 us
delta x 5.900 ns
1/delta x 169.501 MHz

9/5/2012 LGG shot #471 X-ray #1

9/5/2012 LGG shot #471 X-ray #2



471 Anthi



40 mm GUN DATA SHEET

Shot No. 1068 Date 8-9-11

Target:

Sample Material: Molten Hedenbergite (UMICH)
Type of Measurement: Pre-heated EOS 1400°C
Expected Velocity: ~ 2.00 km/sec.

Projectile:

Flyer Material: Mo (#2) Thickness: 2.557 mm 0.1007 in. Weight: 20.4176 gms.
Projectile Material: LEXAN Length: 2.500 in. Dia: 1.5615/1.5616 in.
Weight: 97.6924 gms. Corrected Weight: 93.6924 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle
Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400
Main Charge Weight: 262.34 gms. Powder Type: IMR4350 C/M: 2.80

Laser Distances:

Beam I to Muzzle: ~~68.35/68.48~~ ave 68.415 cm. Co-axial Pin Height: — in.
Beam II to Muzzle: 43.1 cm. Shim Thickness: — in.
Beam III to Muzzle: 1.95 cm. Total Height: — cm.
Beam III to Target: 47.2403 cm. Corrected III to Target Distance: ~~cm.~~

Estimated Times:

Beam I to II: 126.6 µsec.
Beam II to III: 225.25 µsec.
Beam III to Target: 23.62 µsec.

Actual Beam Distances:

Beam I to II: 0.2532 cm.
Beam II to III: 0.4505 cm.
Beam III to Target: 0.047241 cm.

Delays:

→ sheet gives -4627 ns but 6.13 looks good
Xenon Lamp Delay: -6.127 µsec. Lamp Triggered by Laser No.: 3
X-ray 1 to 2 Interval: 16.149 µsec. Camera dial 684 for 5000 µs streak
Cal freq. = 17.9 MHz - 559.4 ns/cycle

Notes:

Used -6.13 Xenon lamp delay
Pulse generator for ~~59~~ 559.4 ns/cycle Cal signal
1400°C @ temp ~ 6 min

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: 17.474 µsec.
UDC 228.15 µsec
Counter 6 X-ray interval 16.991 µsec
Tank/Pump Pressure: 120/110 µm.

HP5-1 128.1920 µsec
HP5-2 128.1400 µsec
HP5-3 4.000 ns ~~µsec~~*
HP5-4 228.1080 µsec

HP6-1 30.80 ns ~~µsec~~*
HP6-2 17.5058 µsec
HP6-3 21.6840 µsec
HP6-4 22.920 µsec

GS7-1 12.36450 µsec
GS7-2 12.23050 µsec*
GS7-3 215.7545 µsec
GS7-4 215.7625 µsec

~29.6000 to

Measured Shot Velocities:

Velocity, X-ray:_____ km/sec.

Backup Velocity, X-ray : 1974.98 km/s
UDC : 1974.6 km/sec

SETUP: SHOT for scopes

HP5 RIGHT!

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V
Ch1 laser1 analog -- downgoing 150mV
Ch2 laser 1 TTL, 4V -- level 2.5V+
Ch4 laser 3 4V TTL -- jog in sig ~2.5V

TOTAL TIME (from wksht): 352 us
Set time 655 us (1µs ns/div)
Delay from trig ~~-170~~ us Need -126
-200

HP6 LEFT!

trig : Ch1 50V+ - second hump (above 30V for 30ns) –lvl 10V+
Ch2 50V+ - second hump (above 30V for 30ns)
Ch3 cam monitor -- -1.75V 500mV/
Ch4 photodiode -- 200 mV/div

TOTAL TIME (from wksht): 23.5 us
Set time 65 us (100 ns/div)
Delay from trig -30 us Need 0

GS7

trig : Ch2 laser 2 TTL -- 4V+
Ch1 laser 2 analog -- -150mV
Ch3 laser 3 analog -- -150mV
Ch4 laser 3 TTL –4V+

TOTAL TIME (from wksht): 225 us
Set time 500 us (____ ns/div) M: 50µs
~~Delay from trig _____ us~~ 11% 29%

40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: 15.836 µsec.
UDC 224.34 µsec
Counter 6 X-ray interval 15.336 µsec

HP5-1 -2.2 µsec
HP5-2 _____ µsec
HP5-3 18.80 ns ~~µsec~~*
HP5-4 _____ µsec

HP6-1 ~~18.80 µs~~ ~~µsec~~*
HP6-2 ~~-2.2~~ µsec
HP6-3 _____ µsec
HP6-4 _____ µsec

Measured Shot Velocities:

UDC : 2008.09 m/sec
Cal frequency ~~151.630~~ MHz

SETUP: SIM for scopes

HP5 RIGHT!

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V
Ch1 Mag sim 1 -- zero crossing (6V)
Ch2 Mag sim 2
Ch4 laser 3 4V TTL -- jog in sig ~2.5V
TOTAL TIME (from wksht): 223.9 us
Set time 327 us (500 ns/div)
Delay from trig -40 us need -2

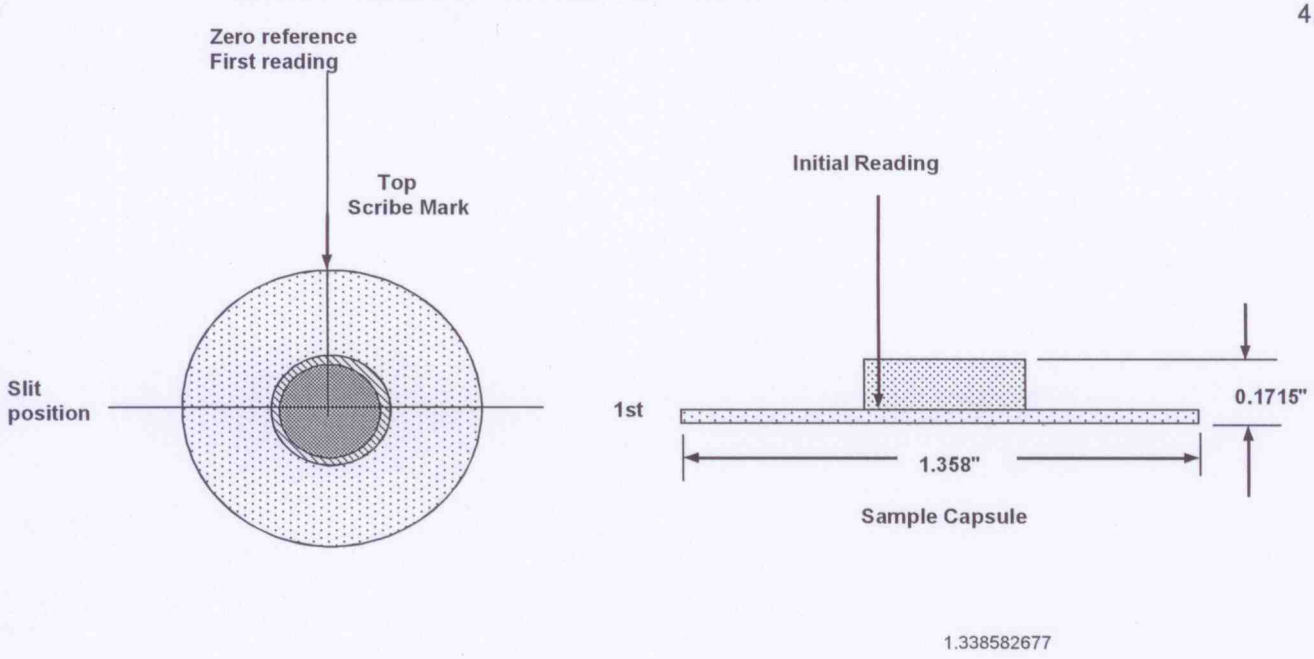
HP6 LEFT!

trig : Ch1 xray 1 50V+
- second hump (above 30V for 30ns) –lvl 10V+
Ch2 xray2 50V+ - second hump (above 30V for 30ns)
Ch3 cam monitor -- first downgoing 500mV/div
Ch4 photodiode—peak brightness 200 mV/div
TOTAL TIME (from wksht) 23.5 us
Set time 65 us (100 ns/div)
Delay from trig ~~-40~~ -20 us Need 0

SAMPLE CAPSULE 13
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

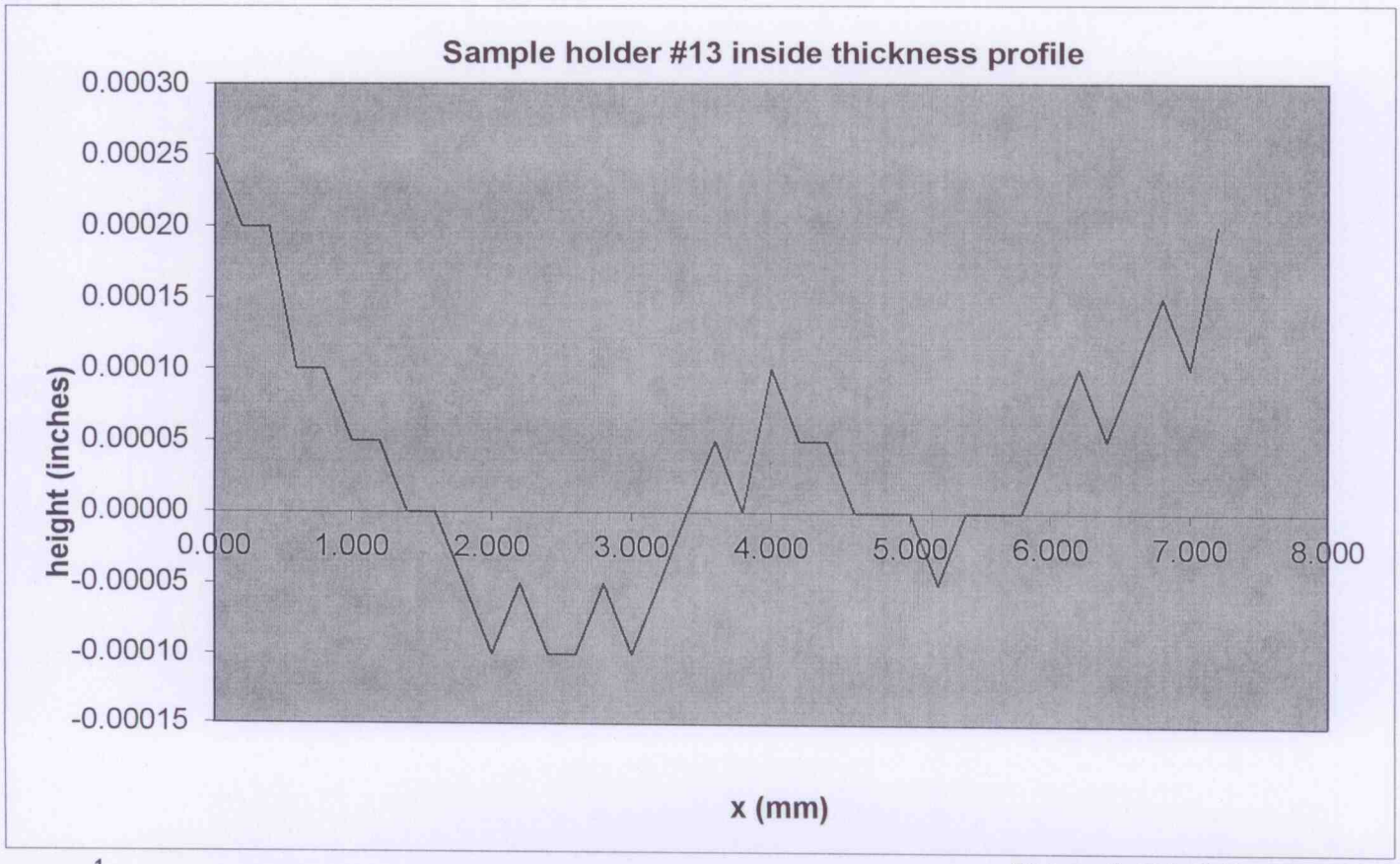
4.625
4.623



1.338582677

Average thickness reading = 0.00003

Note: The thickness of the reference zero point from the base is = **0.03960** Inches
1.00584 mm



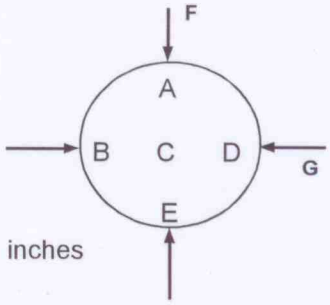
Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis		
1	0.000	0.00025	3.4	south	
2	0.200	0.00020	3.20		
3	0.400	0.00020	3.00		
4	0.600	0.00010	2.80		
5	0.800	0.00010	2.60		
6	1.000	0.00005	2.40		
7	1.200	0.00005	2.20		
8	1.400	0.00000	2.00		
9	1.600	0.00000	1.80		
10	1.800	-0.00005	1.60		
11	2.000	-0.00010	1.40		
12	2.200	-0.00005	1.20		
13	2.400	-0.00010	1.00		
14	2.600	-0.00010	0.80		
15	2.800	-0.00005	0.60		
16	3.000	-0.00010	0.40		
17	3.200	-0.00005	0.20		
18	3.400	0.00000	0.00		
19	3.600	0.00005	-0.20		
20	3.800	0.00000	-0.40		
21	4.000	0.00010	-0.60		
22	4.200	0.00005	-0.80		
23	4.400	0.00005	-1.00		
24	4.600	0.00000	-1.20		
25	4.800	0.00000	-1.40		18
26	5.000	0.00000	-1.60		
27	5.200	-0.00005	-1.80		
28	5.400	0.00000	-2.00		
29	5.600	0.00000	-2.20		
30	5.800	0.00000	-2.40		
31	6.000	0.00005	-2.60		
32	6.200	0.00010	-2.80		
33	6.400	0.00005	-3.00		
34	6.600	0.00010	-3.20		
35	6.800	0.00015	-3.40		
36	7.000	0.00010	-3.60		
37	7.200	0.00020	-3.80	north	

MATERIAL: Hedenbergite sample #13 (capsule 13)

Measurement done by: Claire W. **Date:** 1/14/2011

DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	N/A	F	N/A
A	N/A	F	N/A
B	N/A	G	N/A
B	N/A	G	N/A
C	N/A	**AVE**	N/A
C	N/A		
D	N/A		
D	N/A		
E	N/A		
E	N/A		



inches

Sample consists of 5 pieces and was filled based on mass

Statistic for thickness

N	0			
MAX	0.00000	inch	0.00000	mm
MIN	0.00000	inch	0.00000	mm
Range	0.00000	inch	0.00000	mm
MEAN	#DIV/0!	inch	#DIV/0!	mm
STDEV	#DIV/0!	inch	#DIV/0!	mm

there is some small amount of white wax residue remaining after soaking in acetone for 3 weeks but most has been scraped off with tweezers and a needle.

Statistic for Diameter

N	0			
MAX	0.00000	inch	0.00000	mm
MIN	0.00000	inch	0.00000	mm
Range	0.00000	inch	0.00000	mm
MEAN	#DIV/0!	inch	#DIV/0!	mm
STDEV	#DIV/0!	inch	#DIV/0!	mm

Y MEASUREMENT BY: Russ Oliver 6/18/2009

NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	N/A	N/A	0.29830	N/A	N/A	N/A
2	N/A	N/A	0.29831	N/A	N/A	N/A
3	N/A	N/A	0.29833	N/A	N/A	N/A

THICKNESS:	N/A	±	mm	
FLATNESS:	N/A	mm		
VOLUME:	N/A	N/A	cm^3	
CRYSTAL DENSITY:	N/A	N/A	$grams/cm^3$	
BULK DENSITY:	N/A	N/A	$grams/cm^3$	
AVERAGE MASS	0.29831	1.52753E-05	grams	

corresponds to a 2.1mm nominal bubble-fairly large

SHOT No. ____1068_____ tip used: .7mm long/ flat tip

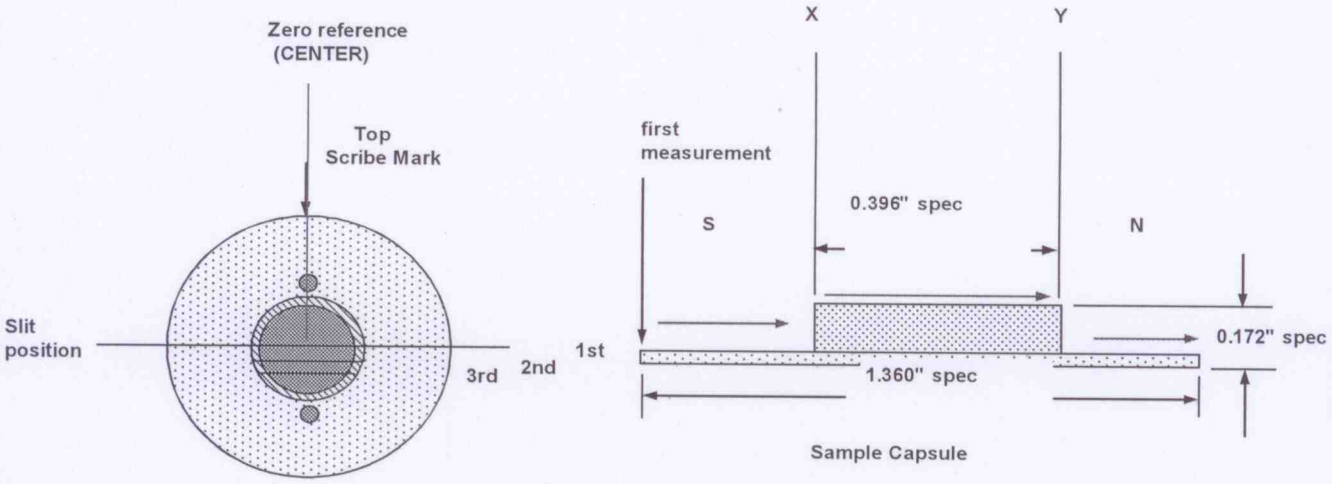
SAMPLE CAPSULE: 13 note: the platform on which the measurement was taken

SAMPLE MATERIAL: Hedenbergite deviates from flat by +0.013 max.

direction of measurement

1.9425

THICKNESS PROFILE (Not re-polished, but final surface) 0.9925



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = 0.00030

Second Run Horizontal (-y) 0.500 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00019

Third Run Horizontal (-y) 01.00 MM Below the center with 0.100 MM increment

3rd Reading

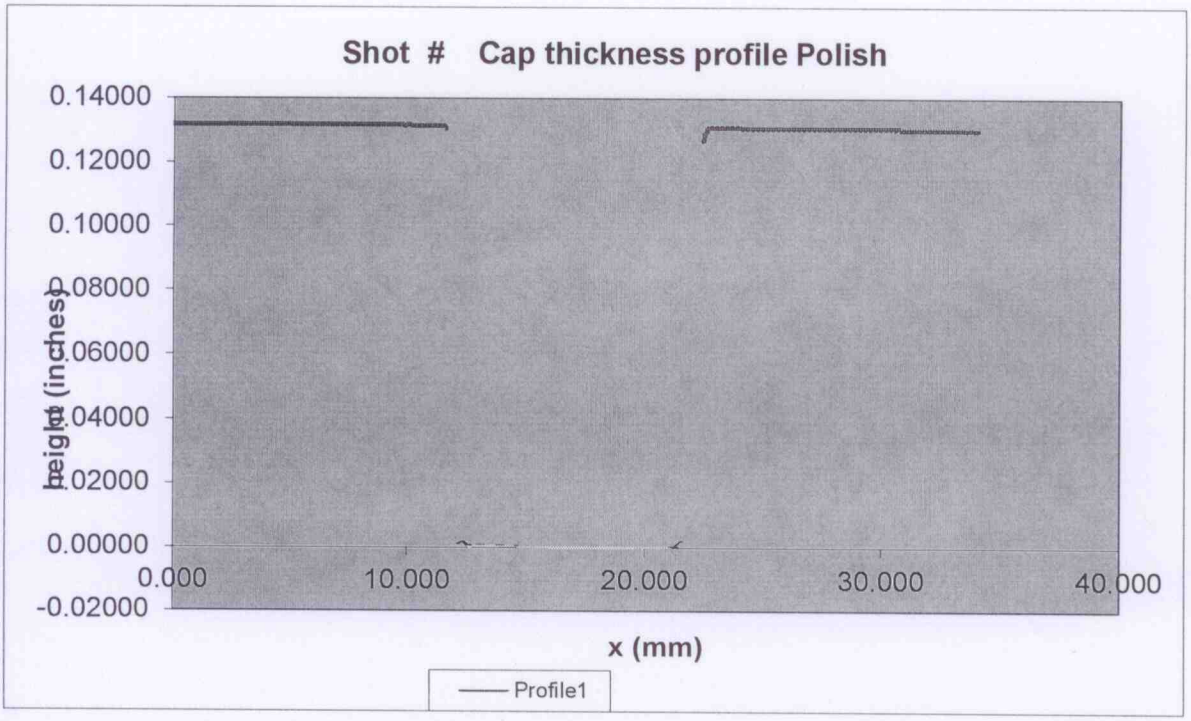
Average thickness reading = 0.00014

Note: Measurement from reference zero point from the base is = **-0.1744** Inches
-4.4285 mm

Average thickness of the driver Plate = 0.04314 Inches
1.0958 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
height (inches)
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) .5 MM Below
3. Third Run Horizontal (-y) 1 MM Below the center with 0.100 MM increment

Number	Reading	abs dist.		Number	Reading	abs dist.	
3	Distance			of	Distance		
Reading	mm	mm	South (left side)	Reading	mm	mm	North(right
1	0.000	17.000	0.131900	225	22.400	-5.400	0.1270
2	0.100	16.900	0.131850	226	22.500	-5.500	0.1292
3	0.200	16.800	0.131850	227	22.600	-5.600	0.1309
4	0.300	16.700	0.131850	228	22.700	-5.700	0.1311
5	0.400	16.600	0.131850	229	22.800	-5.800	0.1310
6	0.500	16.500	0.131850	230	22.900	-5.900	0.1310
7	0.600	16.400	0.131900	231	23.000	-6.000	0.1310
8	0.700	16.300	0.131900	232	23.100	-6.100	0.1310
9	0.800	16.200	0.131850	233	23.200	-6.200	0.1310
10	0.900	16.100	0.131850	234	23.300	-6.300	0.1310
11	1.000	16.000	0.131900	235	23.400	-6.400	0.1310
12	1.100	15.900	0.131850	236	23.500	-6.500	0.1310
13	1.200	15.800	0.131900	237	23.600	-6.600	0.1310
14	1.300	15.700	0.131850	238	23.700	-6.700	0.1310
15	1.400	15.600	0.131900	239	23.800	-6.800	0.1310
16	1.500	15.500	0.131850	240	23.900	-6.900	0.1310
17	1.600	15.400	0.131850	241	24.000	-7.000	0.1309
18	1.700	15.300	0.131850	242	24.100	-7.100	0.1308
19	1.800	15.200	0.131850	243	24.200	-7.200	0.1309
20	1.900	15.100	0.131900	244	24.300	-7.300	0.1309
21	2.000	15.000	0.131900	245	24.400	-7.400	0.1309
22	2.100	14.900	0.131900	246	24.500	-7.500	0.1309
23	2.200	14.800	0.131900	247	24.600	-7.600	0.1309
24	2.300	14.700	0.131900	248	24.700	-7.700	0.1308
25	2.400	14.600	0.131950	249	24.800	-7.800	0.1309
26	2.500	14.500	0.131950	250	24.900	-7.900	0.1309
27	2.600	14.400	0.131950	251	25.000	-8.000	0.1308
28	2.700	14.300	0.131900	252	25.100	-8.100	0.1308
29	2.800	14.200	0.131950	253	25.200	-8.200	0.1308
30	2.900	14.100	0.131900	254	25.300	-8.300	0.1308
31	3.000	14.000	0.131900	255	25.400	-8.400	0.1308
32	3.100	13.900	0.131950	256	25.500	-8.500	0.1308
33	3.200	13.800	0.131900	257	25.600	-8.600	0.1309
34	3.300	13.700	0.131900	258	25.700	-8.700	0.1308
35	3.400	13.600	0.131950	259	25.800	-8.800	0.1309
36	3.500	13.500	0.131900	260	25.900	-8.900	0.1308
37	3.600	13.400	0.131950	261	26.000	-9.000	0.1309
38	3.700	13.300	0.131950	262	26.100	-9.100	0.1309
39	3.800	13.200	0.131950	263	26.200	-9.200	0.1309
40	3.900	13.100	0.131950	264	26.300	-9.300	0.1308
41	4.000	13.000	0.131950	265	26.400	-9.400	0.1308
42	4.100	12.900	0.131900	266	26.500	-9.500	0.1309
43	4.200	12.800	0.131900	267	26.600	-9.600	0.1308
44	4.300	12.700	0.131950	268	26.700	-9.700	0.1308
45	4.400	12.600	0.131950	269	26.800	-9.800	0.1309
46	4.500	12.500	0.131950	270	26.900	-9.900	0.1308
47	4.600	12.400	0.131950	271	27.000	-10.000	0.1308
48	4.700	12.300	0.131950	272	27.100	-10.100	0.1308
49	4.800	12.200	0.131900	273	27.200	-10.200	0.1306
50	4.900	12.100	0.131950	274	27.300	-10.300	0.1306
51	5.000	12.000	0.131950	275	27.400	-10.400	0.1307
52	5.100	11.900	0.131900	276	27.500	-10.500	0.1307
53	5.200	11.800	0.131900	277	27.600	-10.600	0.1308
54	5.300	11.700	0.131900	278	27.700	-10.700	0.1308

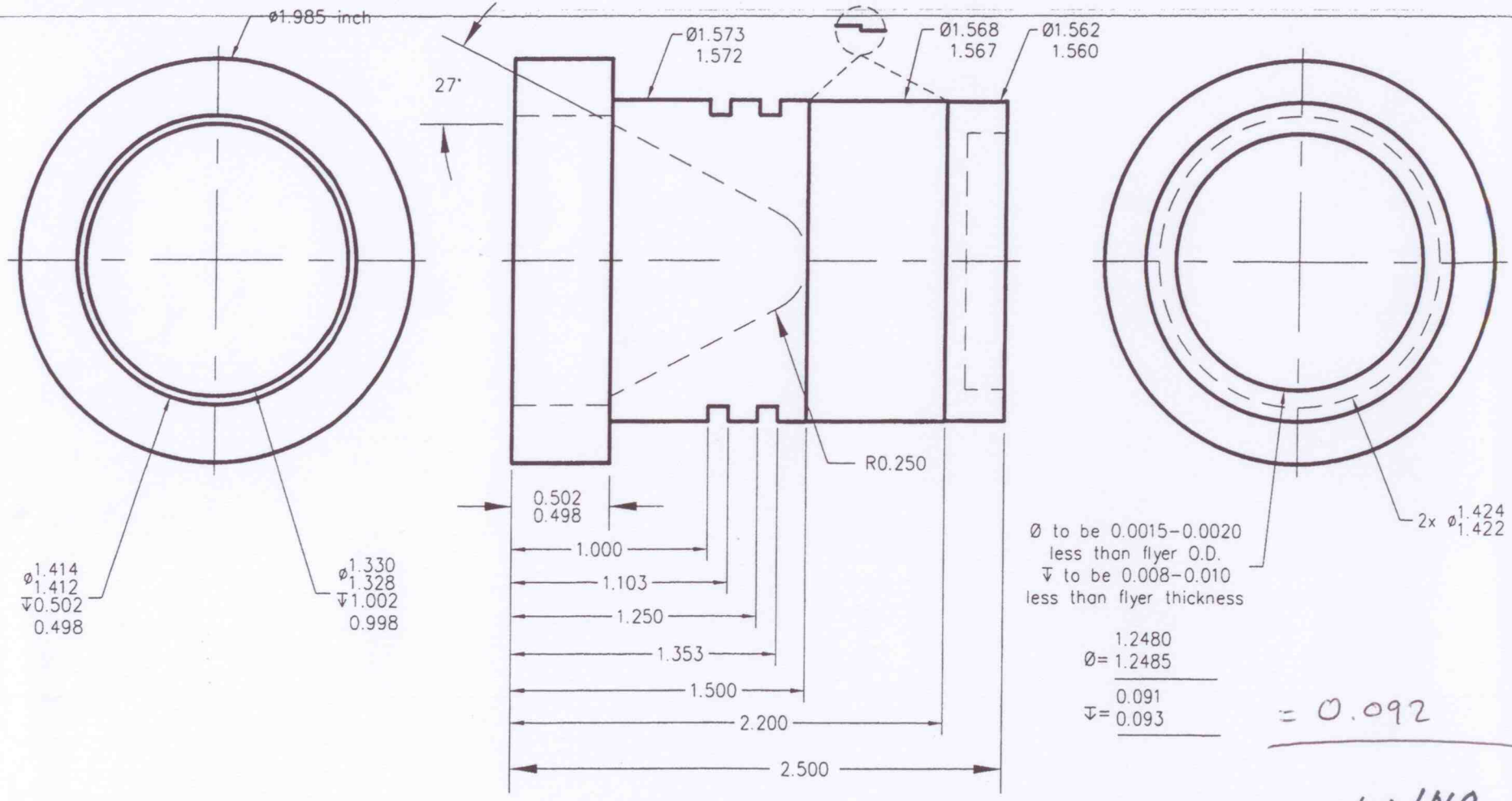
55	5.400	11.600	0.131900	279	27.800	-10.800	0.1308
56	5.500	11.500	0.131900	280	27.900	-10.900	0.1308
57	5.600	11.400	0.131900	281	28.000	-11.000	0.1308
58	5.700	11.300	0.131900	282	28.100	-11.100	0.1308
59	5.800	11.200	0.131900	283	28.200	-11.200	0.1308
60	5.900	11.100	0.131900	284	28.300	-11.300	0.1308
61	6.000	11.000	0.131900	285	28.400	-11.400	0.1308
62	6.100	10.900	0.131900	286	28.500	-11.500	0.1307
63	6.200	10.800	0.131900	287	28.600	-11.600	0.1307
64	6.300	10.700	0.131900	288	28.700	-11.700	0.1307
65	6.400	10.600	0.131900	289	28.800	-11.800	0.1307
66	6.500	10.500	0.131900	290	28.900	-11.900	0.1307
67	6.600	10.400	0.131900	291	29.000	-12.000	0.1307
68	6.700	10.300	0.131900	292	29.100	-12.100	0.1307
69	6.800	10.200	0.131900	293	29.200	-12.200	0.1307
70	6.900	10.100	0.131850	294	29.300	-12.300	0.1307
71	7.000	10.000	0.131850	295	29.400	-12.400	0.1306
72	7.100	9.900	0.131850	296	29.500	-12.500	0.1306
73	7.200	9.800	0.131850	297	29.600	-12.600	0.1306
74	7.300	9.700	0.131850	298	29.700	-12.700	0.1306
75	7.400	9.600	0.131850	299	29.800	-12.800	0.1306
76	7.500	9.500	0.131850	300	29.900	-12.900	0.1306
77	7.600	9.400	0.131850	301	30.000	-13.000	0.1306
78	7.700	9.300	0.131800	302	30.100	-13.100	0.1306
79	7.800	9.200	0.131800	303	30.200	-13.200	0.1306
80	7.900	9.100	0.131850	304	30.300	-13.300	0.1306
81	8.000	9.000	0.131850	305	30.400	-13.400	0.1306
82	8.100	8.900	0.131850	306	30.500	-13.500	0.1305
83	8.200	8.800	0.131850	307	30.600	-13.600	0.1306
84	8.300	8.700	0.131850	308	30.700	-13.700	0.1305
85	8.400	8.600	0.131800	309	30.800	-13.800	0.1305
86	8.500	8.500	0.131800	310	30.900	-13.900	0.1305
87	8.600	8.400	0.131800	311	31.000	-14.000	0.1305
88	8.700	8.300	0.131800	312	31.100	-14.100	0.1305
89	8.800	8.200	0.131800	313	31.200	-14.200	0.1305
90	8.900	8.100	0.131750	314	31.300	-14.300	0.1305
91	9.000	8.000	0.131750	315	31.400	-14.400	0.1304
92	9.100	7.900	0.131750	316	31.500	-14.500	0.1304
93	9.200	7.800	0.131750	317	31.600	-14.600	0.1304
94	9.300	7.700	0.131750	318	31.700	-14.700	0.1304
95	9.400	7.600	0.131750	319	31.800	-14.800	0.1304
96	9.500	7.500	0.131750	320	31.900	-14.900	0.1303
97	9.600	7.400	0.131750	321	32.000	-15.000	0.1304
98	9.700	7.300	0.131750	322	32.100	-15.100	0.1304
99	9.800	7.200	0.131700	323	32.200	-15.200	0.1303
100	9.900	7.100	0.131700	324	32.300	-15.300	0.1303
101	10.000	7.000	0.131750	325	32.400	-15.400	0.1303
102	10.100	6.900	0.131700	326	32.500	-15.500	0.1303
103	10.200	6.800	0.131700	327	32.600	-15.600	0.1303
104	10.300	6.700	0.131700	328	32.700	-15.700	0.1302
105	10.400	6.600	0.131700	329	32.800	-15.800	0.1302
106	10.500	6.500	0.131650	330	32.900	-15.900	0.1303
107	10.600	6.400	0.131650	331	33.000	-16.000	0.1302
108	10.700	6.300	0.131650	332	33.100	-16.100	0.1302
109	10.800	6.200	0.131650	333	33.200	-16.200	0.1302
110	10.900	6.100	0.131650	334	33.300	-16.300	0.1302
111	11.000	6.000	0.131650	335	33.400	-16.400	0.1302
112	11.100	5.900	0.131650	336	33.500	-16.500	0.1301
113	11.200	5.800	0.131700	337	33.600	-16.600	0.1301
114	11.300	5.700	0.131700	338	33.700	-16.700	0.1302
115	11.400	5.600	0.131650	339	33.800	-16.800	0.1301
116	11.500	5.500	0.131650	340	33.900	-16.900	0.1301
117	11.600	5.400	0.130700	341	34.000	-17.000	0.1301

/ the center with 0.100 MM increment

Number of Reading	Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
118	11.700	5.300			
119	11.800	5.200			
120	11.900	5.100			
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	0.00115		
125	12.400	4.600	0.00130		
126	12.500	4.500	0.00175	0.00185	
127	12.600	4.400	0.00185	0.00125	
128	12.700	4.300	0.00110	0.00060	
129	12.800	4.200	0.00075	0.00065	..
130	12.900	4.100	0.00065	0.00055	0.00000
131	13.000	4.000	0.00060	0.00055	0.00055
132	13.100	3.900	0.00065	0.00055	0.00055
133	13.200	3.800	0.00065	0.00055	0.00055
134	13.300	3.700	0.00065	0.00060	0.00060
135	13.400	3.600	0.00065	0.00060	0.00060
136	13.500	3.500	0.00065	0.00060	0.00060
137	13.600	3.400	0.00060	0.00050	0.00050
138	13.700	3.300	0.00060	0.00050	0.00050
139	13.800	3.200	0.00055	0.00045	0.00045
140	13.900	3.100	0.00055	0.00045	0.00045
141	14.000	3.000	0.00050	0.00040	0.00040
142	14.100	2.900	0.00045	0.00040	0.00040
143	14.200	2.800	0.00045	0.00035	0.00035
144	14.300	2.700	0.00045	0.00035	0.00035
145	14.400	2.600	0.00040	0.00035	0.00035
146	14.500	2.500	0.00040	0.00035	0.00035
147	14.600	2.400	0.00035	0.00030	0.00030
148	14.700	2.300	0.00035	0.00030	0.00030
149	14.800	2.200	0.00030	0.00025	0.00025
150	14.900	2.100	0.00030	0.00020	0.00020
151	15.000	2.000	0.00025	0.00020	0.00020
152	15.100	1.900	0.00025	0.00020	0.00020
153	15.200	1.800	0.00025	0.00020	0.00020
154	15.300	1.700	0.00025	0.00015	0.00015
155	15.400	1.600	0.00020	0.00015	0.00015
156	15.500	1.500	0.00020	0.00015	0.00015
157	15.600	1.400	0.00015	0.00015	0.00015
158	15.700	1.300	0.00015	0.00015	0.00015
159	15.800	1.200	0.00010	0.00010	0.00010
160	15.900	1.100	0.00010	0.00010	0.00010
161	16.000	1.000	0.00010	0.00010	0.00010
162	16.100	0.900	0.00010	0.00010	0.00010
163	16.200	0.800	0.00005	0.00005	0.00005
164	16.300	0.700	0.00005	0.00005	0.00005
165	16.400	0.600	0.00000	0.00000	0.00000
166	16.500	0.500	0.00000	0.00000	0.00000
167	16.600	0.400	0.00005	0.00005	0.00005
168	16.700	0.300	0.00000	0.00000	0.00000
169	16.800	0.200	0.00000	0.00000	0.00000
170	16.900	0.100	0.00000	0.00000	0.00000
171	17.000	0.000	0.00000	0.00000	0.00000

172	17.100	-0.100	-0.00005	-0.00005	-0.00005
173	17.200	-0.200	-0.00005	-0.00005	-0.00005
174	17.300	-0.300	-0.00005	-0.00005	-0.00005
175	17.400	-0.400	-0.00005	-0.00005	-0.00005
176	17.500	-0.500	-0.00005	-0.00005	-0.00005
177	17.600	-0.600	-0.00005	-0.00005	-0.00005
178	17.700	-0.700	-0.00005	-0.00005	-0.00005
179	17.800	-0.800	-0.00005	-0.00005	-0.00005
180	17.900	-0.900	-0.00005	-0.00005	-0.00005
181	18.000	-1.000	-0.00005	-0.00005	-0.00005
182	18.100	-1.100	-0.00005	-0.00005	-0.00005
183	18.200	-1.200	0.00000	0.00000	0.00000
184	18.300	-1.300	-0.00005	-0.00005	-0.00005
185	18.400	-1.400	-0.00005	-0.00005	-0.00005
186	18.500	-1.500	-0.00005	-0.00005	-0.00005
187	18.600	-1.600	-0.00005	-0.00005	-0.00005
188	18.700	-1.700	-0.00005	-0.00005	-0.00005
189	18.800	-1.800	0.00000	0.00000	0.00000
190	18.900	-1.900	0.00000	0.00000	0.00000
191	19.000	-2.000	0.00000	0.00000	0.00000
192	19.100	-2.100	0.00000	0.00000	0.00000
193	19.200	-2.200	0.00000	0.00000	0.00000
194	19.300	-2.300	0.00000	0.00000	0.00000
195	19.400	-2.400	0.00000	0.00000	0.00000
196	19.500	-2.500	0.00005	0.00005	0.00005
197	19.600	-2.600	0.00005	0.00005	0.00005
198	19.700	-2.700	0.00005	0.00005	0.00005
199	19.800	-2.800	0.00010	0.00010	0.00010
200	19.900	-2.900	0.00010	0.00010	0.00010
201	20.000	-3.000	0.00005	0.00005	0.00005
202	20.100	-3.100	0.00005	0.00005	0.00005
203	20.200	-3.200	0.00005	0.00005	0.00005
204	20.300	-3.300	0.00010	0.00010	0.00010
205	20.400	-3.400	0.00010	0.00010	0.00010
206	20.500	-3.500	0.00015	0.00015	0.00015
207	20.600	-3.600	0.00010	0.00010	0.00010
208	20.700	-3.700	0.00015	0.00015	0.00015
209	20.800	-3.800	0.00015	0.00015	0.00015
210	20.900	-3.900	0.00020	0.00020	0.00020
211	21.000	-4.000	0.00020	0.00020	0.00020
212	21.100	-4.100	0.00015	0.00015	0.00015
213	21.200	-4.200	0.00015	0.00015	0.00015
214	21.300	-4.300	0.00020	0.00020	0.00000
215	21.400	-4.400	0.00025	0.00025	
216	21.500	-4.500	0.00065	0.00065	
217	21.600	-4.600	0.00130	0.00000	
218	21.700	-4.700	0.00200		
219	21.800	-4.800	0.00210		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

1068



shot 1068

Note: Use only Westlake Plastics
Zelux M Polycarbonate

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN	M. Long	DATE 3/20/09
ENGINEER		DATE
APPROVED		DATE

MATERIAL: Polycarbonate

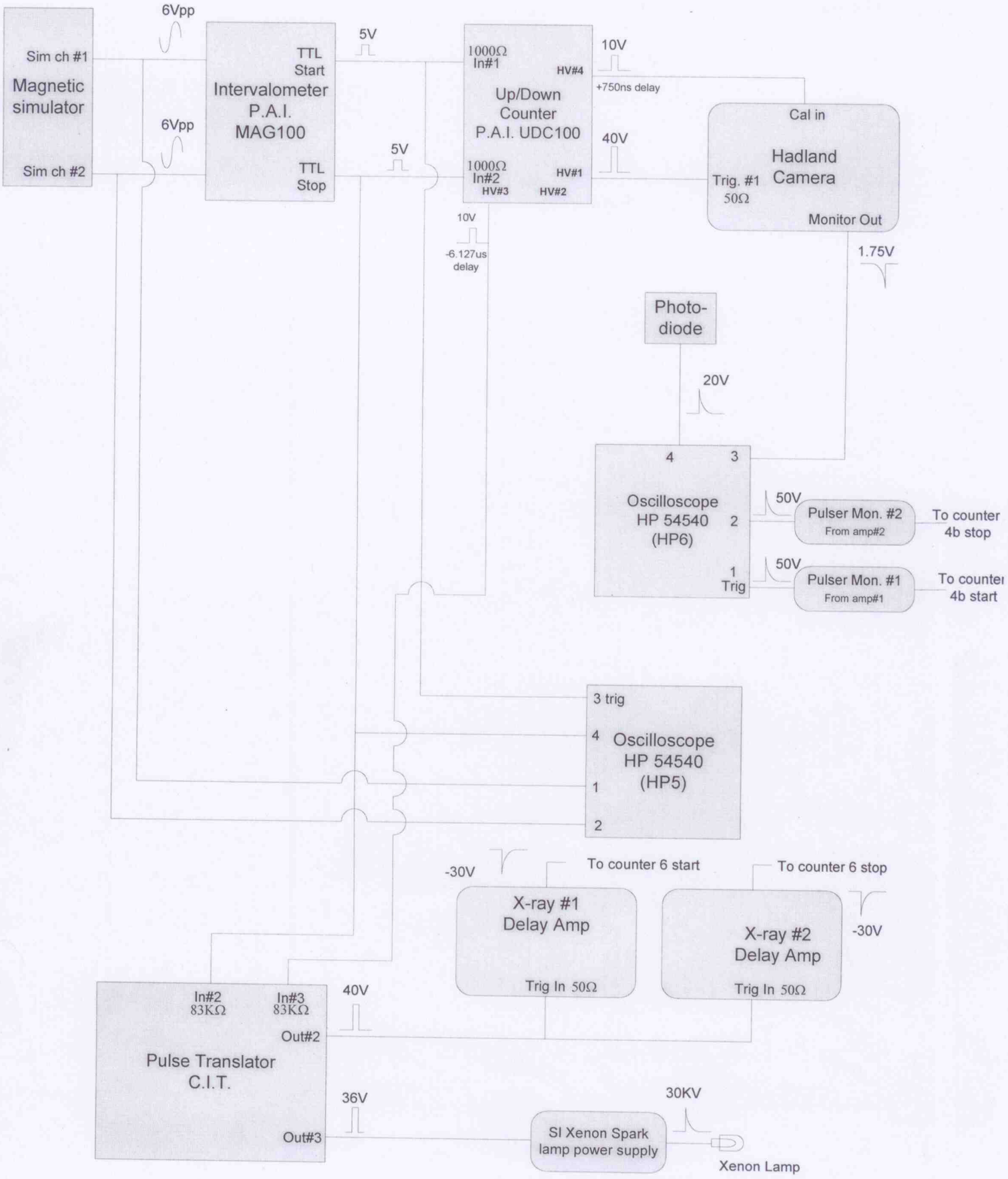
CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

TITLE: 40 mm Propellant Projectile Sabot

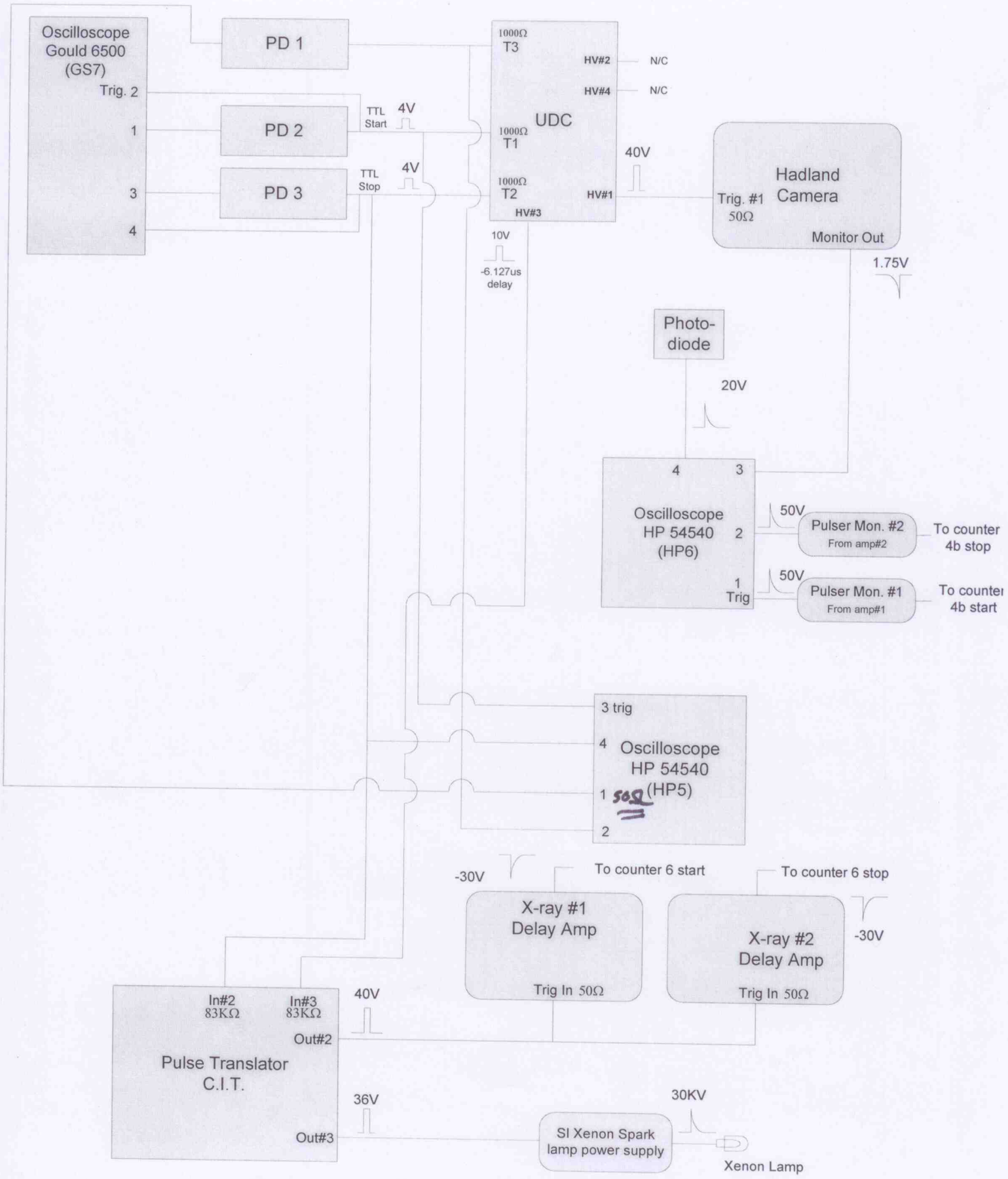
SCALE: 2:1 | SHEET: 1 of 2 | B | DRAWING NUMBER: 40mm-048

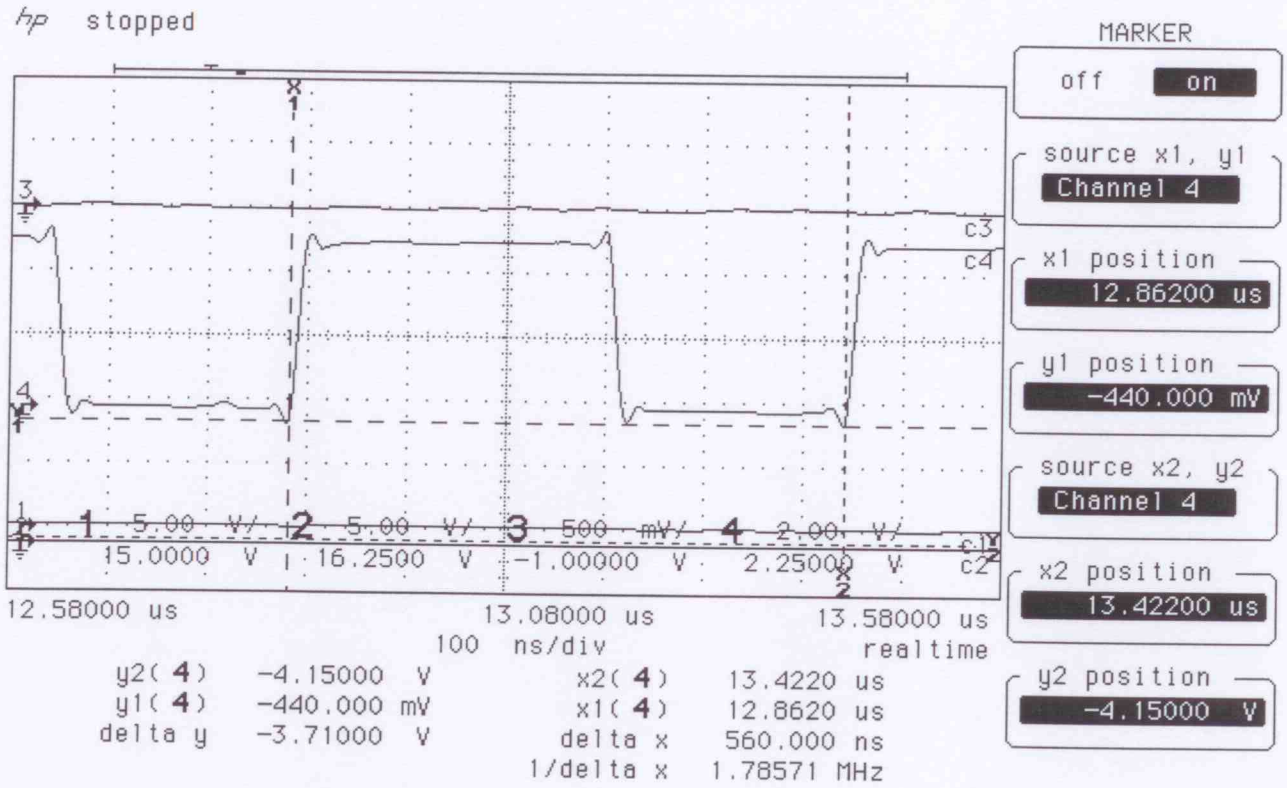
Shot #1068 Scope Schematic for SIM

Live camera
Live lamp
Live x-ray

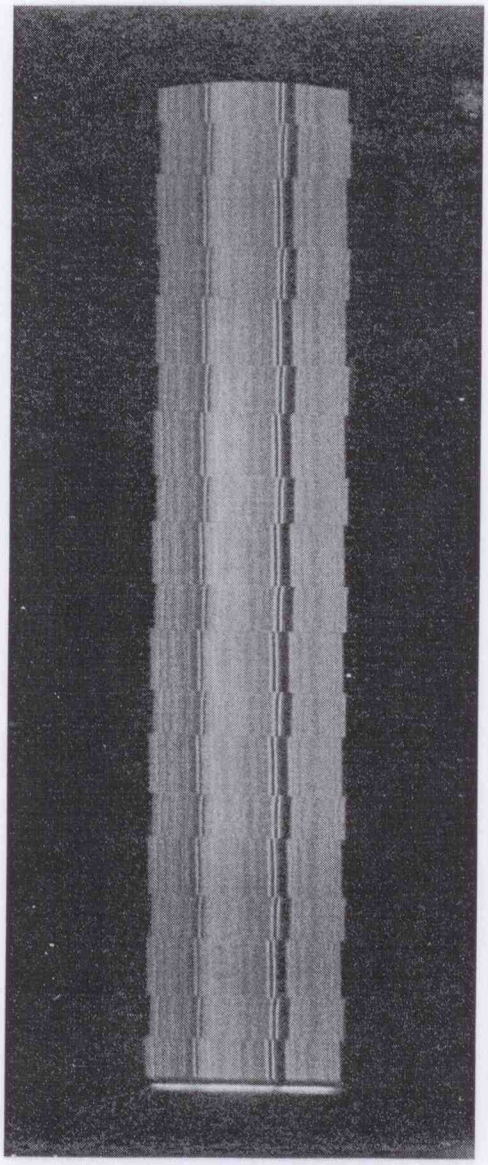


Shot #1068 Scope Schematic



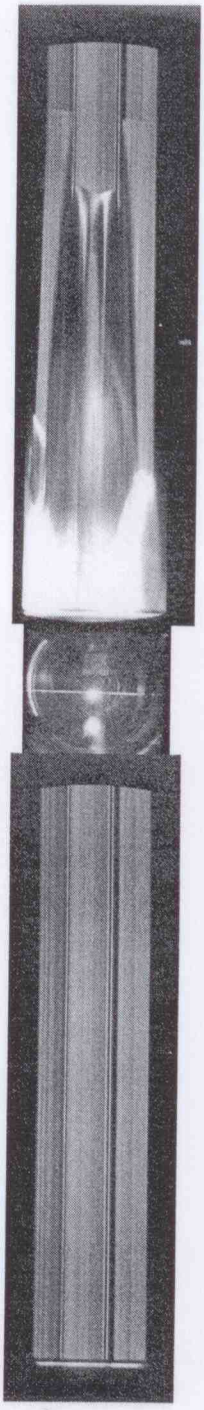


Cal 1068



1.4 ns/cycle 559.4 ns/cycle

SHOT 106B



f8

40 mm hot EOS shot Nominal Timeline Preshot

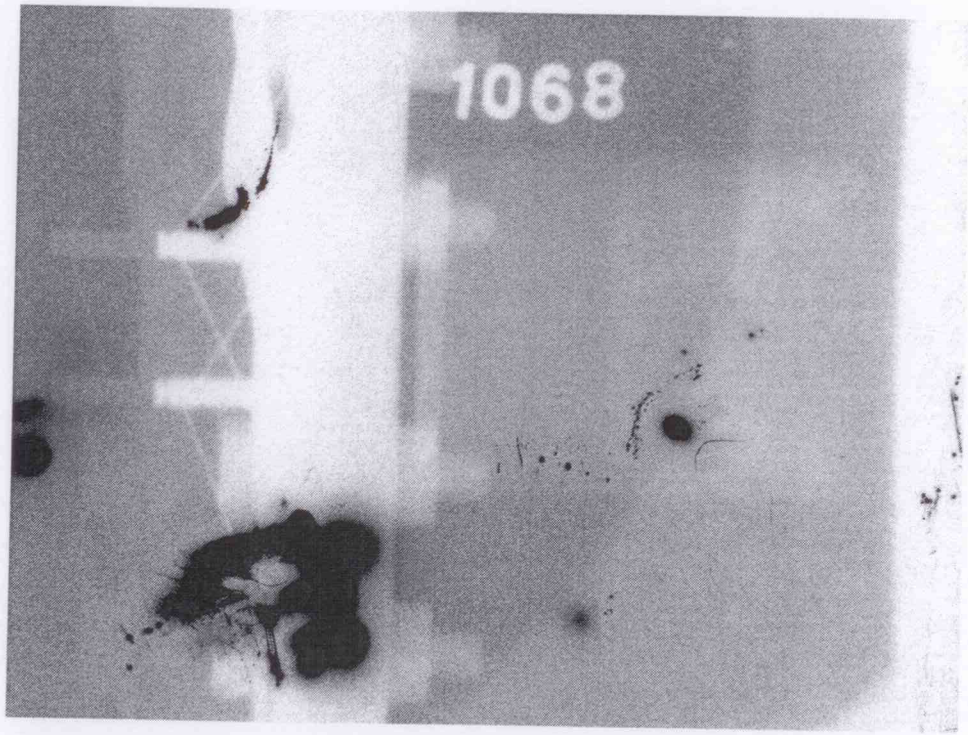
V	2000			
cable time	75			
photodiode intrinsic delays	[redacted]			
UDC extra count lag	118	2140	2140	
pulse translator delay	150			
X-ray 1 program delay	0	971	X-ray 1 delay amp intrinsic	
X-ray 2 program delay	17330	1216	X-ray 2 delay amp intrinsic	
X-ray 1 pulser delay	426			
X-ray 2 pulser delay	887			
amp trigger to peak bright	[redacted]			
HV3 program delay	-4627	~6.13μs		
Camera intrinsic delay	107			
Streak duration	5000			
d dead streak before driver	750			

Laser1-Laser2 distance	0.2532
Laser2-Laser3 distance	0.4505
Laser3-target distance	0.04724
Laser3-target fudge	0.044942
Laser3-Xray2 % of Laser3-target	80
Us(Mo)	6231.07346
driver thickness	0.00109598
sample thickness	0.00254
cap thickness	0.00078257
estimated sample+cover time	560.662806

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-126600	-0.2532		Laser 1 actual interrupt		HP5-1
-126400	-0.2528		Laser 1 TTL out		
-126325	-0.25265		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
200	0.0004		Laser 2 TTL out (shot)		GS7-2 & Trig
-1865	-0.00373		Magnet Sim 1 analog (sim)	HP5-1	
275	0.00055		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
225250	0.4505		Laser 3 actual interrupt		GS7-3
225450	0.4509		Laser 3 TTL out		GS7-4
223385	0.44677		Magnet Sim 2 analog (sim)	HP5-2	
225525	0.45105		Laser 3 TTL at UDC (start down-count) and pulse translat	HP5-4, UDC stop	HP5-4, UDC stop
225750	0.4515		Pulse translator out reaches X-ray delay amps 1 & 2		
226721	0.453442		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
227147	0.454294		X-ray 1 fires		
227222	0.454444		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
244296	0.488592		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
245183	0.488292		X-ray 2 fires		
245258	0.490516		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
243487	0.48697378		HV3 out to lamp		
248114	0.49622778		UDC zero time, HV1 out to camera		
248189	0.49637778		Trigger at camera		
248296	0.49659178		Begin Streak		
248371	0.49674178		Camera Monitor reaches control lab	HP6-3	HP6-3
250764	0.50152778		Lamp Peak Bright	HP6-4	HP6-4
248870	0.49774	0	IMPACT		
249046		0.001095985	Driver arrival on streak	Driver cutoff on streak	750
249607		0.004589516	Sample cutoff on streak	Sample cutoff on sreak	1311
253296		0.027578047	End Streak		

	rho0	Co	s		
Cold Mo	10206	5033	1.28946405		
Hot Mo	9937	4918.5831	1.28837124	1407	
Liquid Hd	2926	2602	1.5714		
				up	p
driver	357.7250824	-152883839	1.55375E+11	1018.72063	63.0773243
sample	8204.628612	-108658279	1.52727E+11	1598.51972	23.9191493
cap	-8204.62861	-85888852	71336091029	773.421039	45.4599237
Cold Mo	10206	5033	1.28946405		
Hot Mo	9961.5	4927.8728	1.288702471	1300	
	9937	4918.5831	1.28837124	1407	
	9913	4908.7717	1.2882417	1508	
	9875	4893.13	1.28807834	1659	

	SIM	SHOT
HP5 1	-2140	-126875
HP5 2	223110	-126600
HP5 3	0	0
HP5 4	225250	225250
UDC upcount	225250	225250
HP6 1	0	0
HP6 2	18036	18036
HP6 3	21149	21149
HP6 4	23542	23542
GS7 1		-275
GS7 2		0
GS7 3		225050
GS7 4		225250
Counter 4b:	18036	18036
Counter 6:	17575	17575


1068

40 mm GUN DATA SHEET

Shot No. 1069 Date 8-17-11

Target:

Sample Material: Anorthite - Diopside - Hd Mix (sample #16)
Type of Measurement: Pre-heated EOS 1400°C
Expected Velocity: 2.00 km/sec.

Projectile:

Flyer Material: Mo (#3) Thickness: 0.10060 in. Weight: 20.4471 gms.
Projectile Material: LEXAN Length: 2.501 in. Dia: .5559/.5660 in.
Weight: 97.6692 gms. Corrected Weight: 93.6692 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle
Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400
Main Charge Weight: 271.641 gms. Powder Type: IMR4350 C/M: 2.90

Laser Distances:

Beam I to Muzzle: 68.5 / 68.5 cm. Co-axial Pin Height: — in.
Beam II to Muzzle. 43.15 / 43.15 cm. Shim Thickness: — in.
Beam III to Muzzle 2.1 / 2.1 .m. Total Height: — cm.
Beam III to Target: 53.357 mm. Corrected III to Target Distance: — cm.

Estimated Times:

Beam I to II: 126.75 µsec.
Beam II to III: 226.25 µsec.
Beam III to Target: 26.6785 µsec.

Actual Beam Distances:

Beam I to II: 0.2535 m.
Beam II to III: 0.4525 m.
Beam III to Target: 0.053357 m.

Delays:

Xenon Lamp Delay: -6.127 µsec. Lamp Triggered by Laser No.: 3
X-ray 1 to 2 Interval: 18.442 µsec. Camera dial 270 for 2000 ns streak

Notes:

1400°C - 3 min @ temp
Sig. strength · 0.167

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: 18.711 µsec.
UDC 224.97 µsec
Counter 6 X-ray interval 18.402 µsec
Tank/Pump Pressure: 110/120 µm.

HP6-1 37.40 ns*
HP6-2 18.7484 µsec
HP6-3 24.184 µsec -26.854
HP6-4 25.710 µsec

HP5-1 126.570 µsec
HP5-2 126.517 µsec
HP5-3 4.000 ns*
HP5-4 224.930 µsec

GS7-1 23.8475 µsec
GS7-2 23.9815 ns*
GS7-3 248.7820 µsec
GS7-4 248.9300 µsec

Measured Shot Velocities:

Velocity, X-ray:_____ km/sec.

Backup Velocity, X-ray : _____ km/s
UDC : 2011.41 km/sec

SETUP: SHOT for scopes

HP6

trig : Ch1 50V+ - second hump (above 30V for 30ns) –lvl 10V+
Ch2 50V+ - second hump (above 30V for 30ns)
Ch3 cam monitor -- -1.75V -- set 500mV
Ch4 photodiode—peak brightness—set 200mV

TOTAL TIME (from wksht): 290.7 us
Set time 327 us (500 ns/div)
Delay from trig -40 us (need: 0)

HP5

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V
Ch1 laser1 analog -- downgoing 150mV 50mV/div
Ch2 laser 1 TTL, 4V -- level 2.5V+ 2V
Ch4 laser 3 4V TTL -- jog in sig ~2.5V

TOTAL TIME (from wksht): 352.12 us
Set time 665 us (1 µs ns/div)
Delay from trig -250 us (need: -1268 µs)

GS7

trig : Ch2 laser 2 TTL -- 4V+
Ch1 laser 2 analog -- -150mV
Ch3 laser 3 analog -- -150mV
Ch4 laser 3 TTL –4V+

TOTAL TIME (from wksht): 226 us
Set time 500 us (M: 50 us)
Pretrigger view 9 %

50mV 1V 50mV 1V CHECK!!

40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: ____ µsec.
UDC 223.19 µsec
Counter 6 X-ray interval 18.610 µsec

HP6-1 41.60 ns*
HP6-2 19.160 µsec
HP6-3 23.98 µsec ~ 26.8
HP6-4 25.64 µsec

HP5-1 21100 µsec
HP5-2 221.10 µsec
HP5-3 17.60 ns*
HP5-4 223.263 µsec

Measured Shot Velocities:

UDC : 2027.43 m/sec
Cal frequency 147.9850 MHz

SETUP: SIM for scopes

HP6

trig : Ch1 xray 1 50V+ 5V/div
- second hump (above 30V for 30ns) –lvl 10V+
Ch2 xray2 50V+ 5V - second hump (above 30V for 30ns)
Ch3 cam monitor -- -1.75V -- set 500mV
Ch4 photodiode—peak brightness—set 200mV
TOTAL TIME (from wksht): 250.7 us
Set time 327 us (500 ns/div)
Delay from trig -40 us (need: 0 s)

HP5

trig Ch3 laser 2 5V TTL -- jog in sig ~2.5V 2V/
Ch1 Mag sim 1 -- zero crossing (6V) 2V/
Ch2 Mag sim 2 2V/
Ch4 laser 3 5V TTL -- jog in sig ~2.5V 2V/
TOTAL TIME (from wksht): 2284 us
Set time 827 us (500 ns/div)
Delay from trig -40 us (need: -2 µs)

40 mm hot EOS shot Nominal Timeline Preshot

V	2000			Laser1-Laser2 distance	0.2535
cable time	75			Laser2-Laser3 distance	0.4525
photodiode intrinsic delays	[redacted]			Laser3-target distance	0.053357
UDC extra count lag	118	2140	2140	Laser3-target fudge	0.050929
pulse translator delay	150			Laser3-Xray2 % of Laser3-target	75
X-ray 1 program delay	0	971	X-ray 1 delay amp intrinsic		
X-ray 2 program delay	18442.875	1216	X-ray 2 delay amp intrinsic		
X-ray 1 pulser delay	426			Us(Mo)	6231.07346
X-ray 2 pulser delay	887			driver thickness	0.00069088
amp trigger to peak bright	[redacted]			sample thickness	0.00254
HV3 program delay	-6127			cap thickness	0.00078511
Camera intrinsic delay	107			estimated sample+cover time	553.926333
Streak duration	2000				
d dead streak before driver	750				

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-126750	-0.2535		Laser 1 actual interrupt		HP5-1
-126550	-0.2531		Laser 1 TTL out		
-126475	-0.25295		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
200	0.0004		Laser 2 TTL out (shot)		GS7-2 & Trig
-1865	-0.00373		Magnet Sim 1 analog (sim)	HP5-1	
275	0.00055		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
226250	0.4525		Laser 3 actual interrupt		GS7-3
226450	0.4529		Laser 3 TTL out		GS7-4
224385	0.44877		Magnet Sim 2 analog (sim)	HP5-2	
226525	0.45305		Laser 3 TTL at UDC (start down-count) and pulse transla	HP5-4, UDC stop	HP5-4, UDC stop
226750	0.4535		Pulse translator out reaches X-ray delay amps 1 & 2		
227721	0.455442		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
228147	0.456294		X-ray 1 fires		
228222	0.456444		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
246409	0.49281775		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
247296	0.49251775		X-ray 2 fires		
247371	0.49474175		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
245980	0.49196075		HV3 out to lamp		
252107	0.50421475		UDC zero time, HV1 out to camera		
252182	0.50436475		Trigger at camera		
252289	0.50457875		Begin Streak		
252364	0.50472875		Camera Monitor reaches control lab	HP6-3	HP6-3
253257	0.50651475		Lamp Peak Bright	HP6-4	HP6-4
252929	0.505857	0	IMPACT		
253039		0.00069088	Driver arrival on streak	Driver cutoff on streak	750
253593		0.004142436	Sample cutoff on streak	Sample cutoff on sreak	1304
254289		0.008479722	End Streak		

	rho0	Co	s		
Cold Mo	10206	5033	1.28946405		
Hot Mo	9937	4918.5831	1.28837124	1407	
Liquid An-Di-Hd	[redacted]		1.5714		

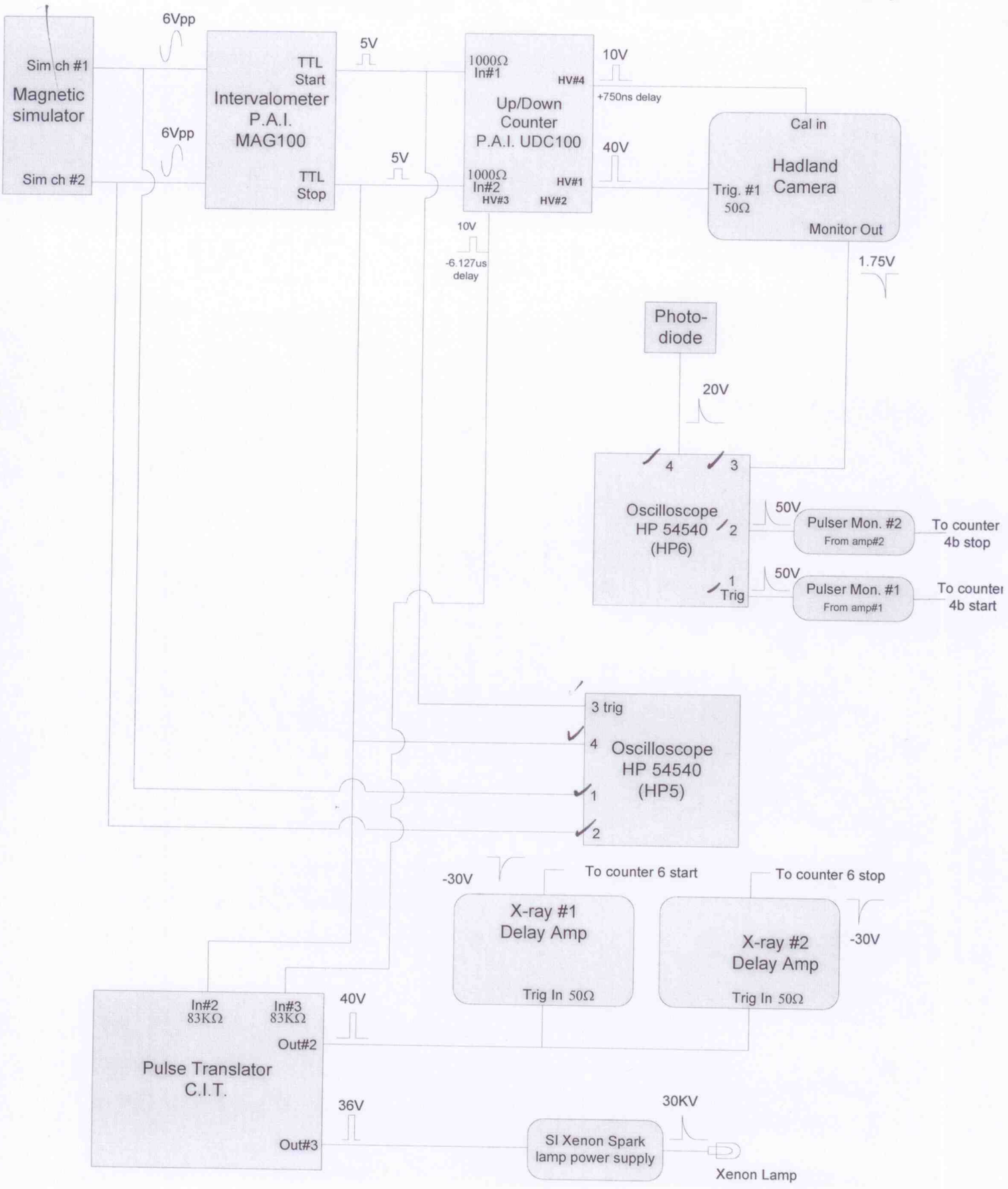
				up	P	Us
driver	357.7250824	-152883839	1.55375E+11	1018.72063	63.0773243	6231.07346
sample	8500.08324	-108836571	1.52727E+11	1604.27818	23.5734064	5366.76273
cap	-8500.08324	-84277086	69293377419	763.42648	44.7747814	5902.15982

Cold Mo	10206	5033	1.28946405		
Hot Mo	9961.5	4927.8728	1.288702471	1300	
	9937	4918.5831	1.28837124	1407	
	9913	4908.7717	1.2882417	1508	
	9875	4893.13	1.28807834	1659	

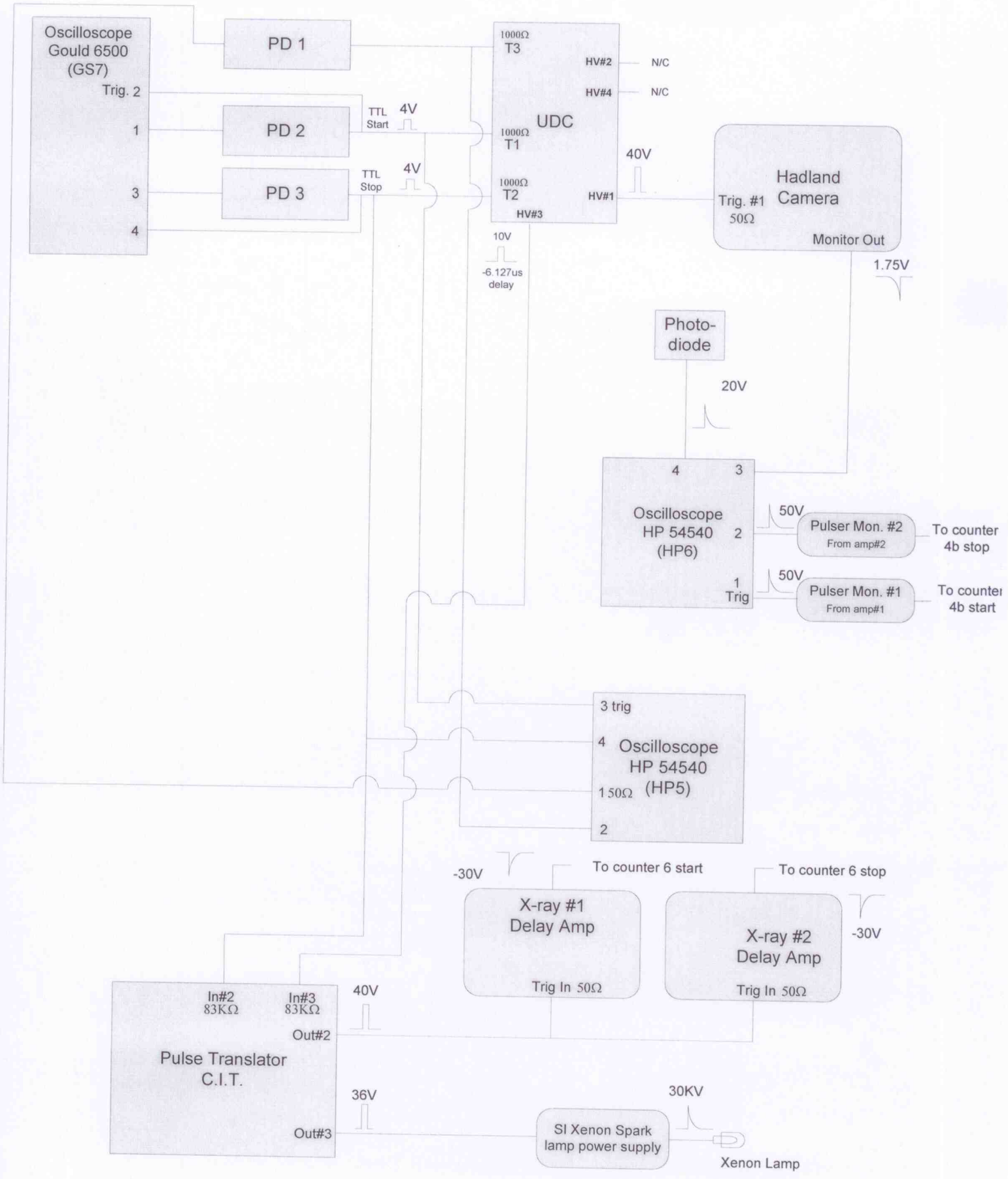
	SIM	SHOT		
HP5 1	-2140	-127025		
HP5 2	224110	-126750		
HP5 3	0	0	228390	353275
HP5 4	226250	226250		
UDC upcount:	226250	226250		
HP6 1	0	0		
HP6 2	19149	19149		
HP6 3	24142	24142		
HP6 4	25035	25035		
GS7 1		-275		
GS7 2		0		
GS7 3		226050		
GS7 4		226250		
Counter 4b:	19149	19149		
Counter 6:	18688	18688		

Shot #1069 Scope Schematic for SIM

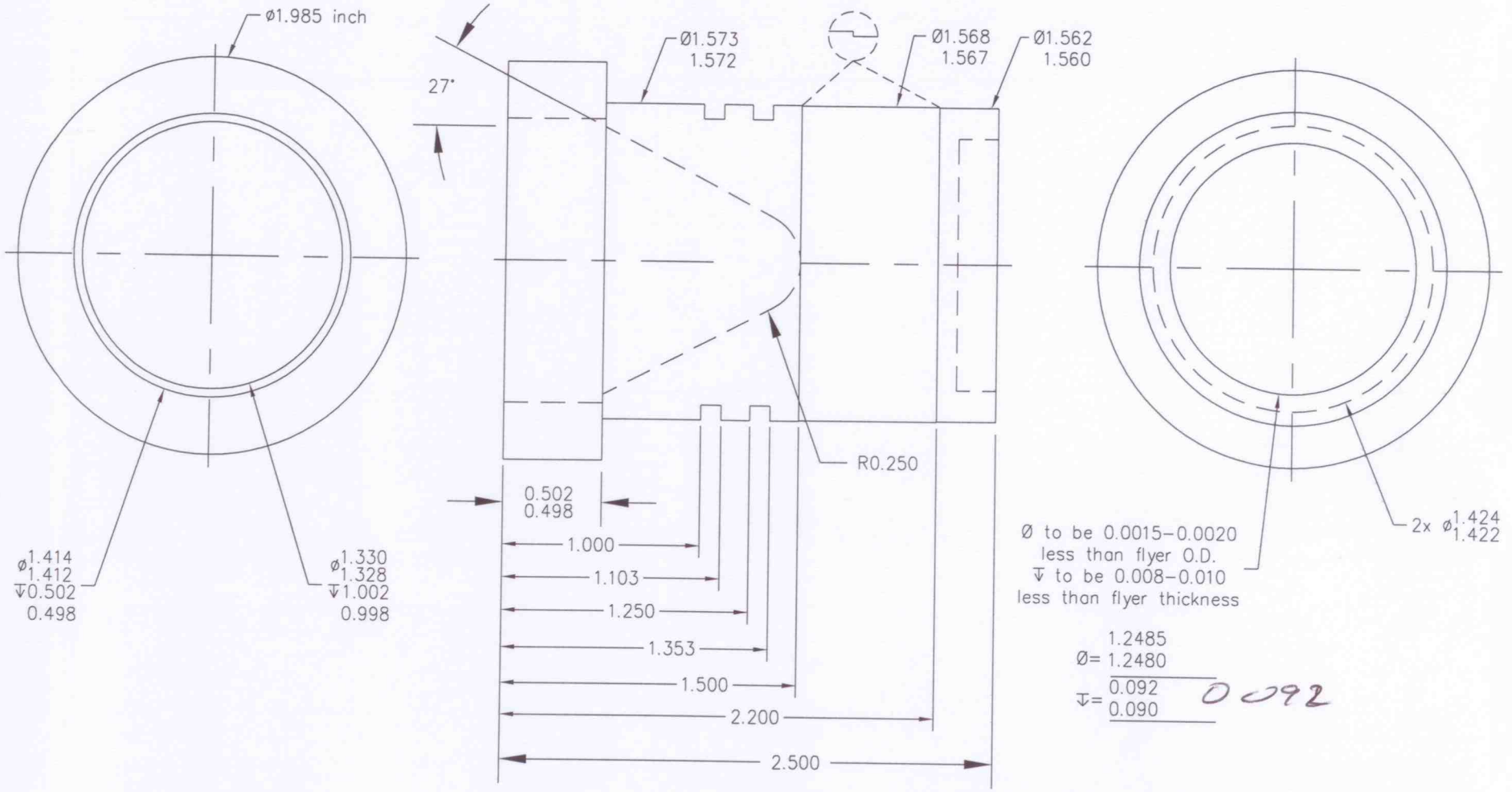
Live camera
Live lamp
Live x-ray



Shot #1069 Scope Schematic



1069



Note: Use only Westlake Plastics
Zelux M Polycarbonate

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

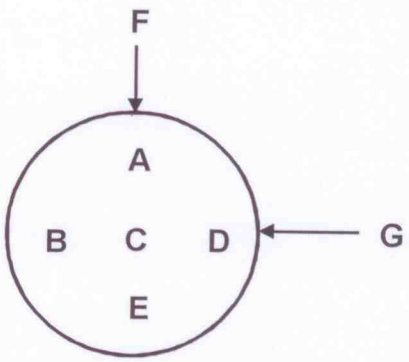
FINISH: 16

DRAWN: M. Long	DATE: 3/20/09	CALIFORNIA INSTITUTE of TECHNOLOGY SHOCK WAVE LABORATORY
ENGINEER	DATE	TITLE: 40 mm Propellant Projectile Sabot
APPROVED	DATE	
MATERIAL: Polycarbonate	SCALE: 2:1	SHEET: 1 of 2
		B
		DRAWING NUMBER: 40mm-048C

SHOT No. 1069

FLYER PLATE MATERIAL: Mo #3 6/23/2011

Measurement done by: Russ



DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.10105	F	1.25000
A	0.10105	F	1.25000
B	0.10095	G	1.25000
B	0.10095	G	1.25000
C	0.10100		
C	0.10100		
D	0.10100		
D	0.10095		
E	0.10070		
E	0.10060		

Statistic for thickness

N	10
MAX	0.10105
MIN	0.10060
Range	0.00045
MEAN	0.100985714
	2.565037143
STDEV	3.77964E-05

Statistic for Diameter (F-G)

N	4	
MAX	1.25000	
MIN	1.25000	
Range	0.00000	
MEAN	1.2500000	inch
	31.7500000	mm
STDEV	0	

	Sample in Air	Crystal Density	
1	20.44714	10.142	
2	20.44710	10.153	
3	20.44706	10.146	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.100985714	±	in
FLATNESS:	0.00045	in.	
VOLUME:	2.0308	9.60E-05	cm^3
CRYSTAL DENSITY:	10.1470	#DIV/0!	$grams/cm^3$
BULK DENSITY:	10.0684	#DIV/0!	$grams/cm^3$
DENSITIES CHECKED BY: _____		on _____	
MEASUREMENT CHECKED E	Russ	6/23/2011	

40mm - Mo#3 flyer

SHOT No. ____1069_____

LGG Moly Capsule Cap

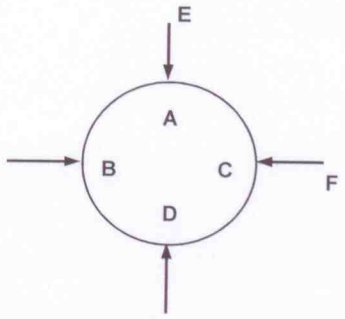
SAMPLE MATERIAL: Mo 16

11/18/2010

Post polish

Thickness Measurement

A	0.03090
A	0.03100
B	0.03095
B	0.03100
C	0.03085
C	0.03080
D	0.03085
D	0.03090



Diameter Measurement

E	0.35400
E	0.35400
F	0.35400
F	0.35350
AVE	0.35388
Radius	0.1769

Statistic for thickness

N	8
MAX	0.03100
MIN	0.0308
Range	0.0002
MEAN	0.03091
STDEV	7.28869E-05

Statistic for perimeter

N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.353875
STDEV	0.00025

post-polish:

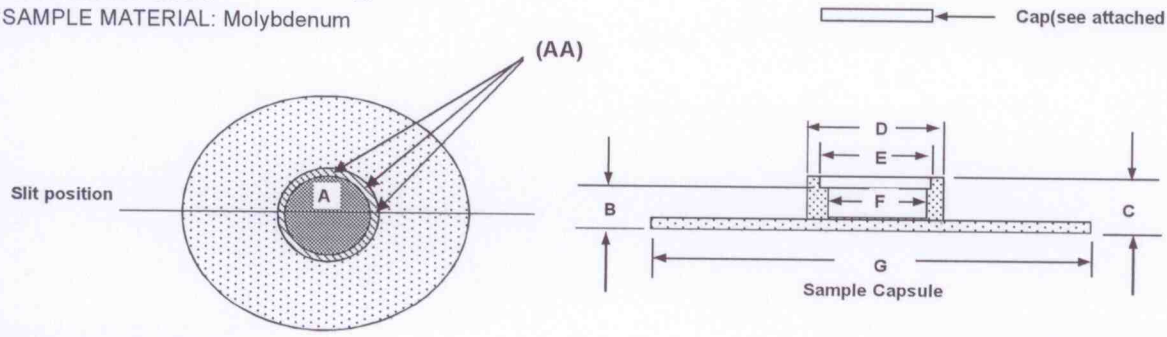
DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03090625	±	mm	
	FLATNESS:		0.0002			
	VOLUME:		0.0498		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		9.9827		$grams/cm^3$	

SHOT No.: 1069 post polish

11/18/2010

SAMPLE CAPSULE: 16

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04110
A	0.04120
A	0.04135
A	0.04115
Avg	0.04120

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3540
E	0.3535
F	0.3140
F	0.3145

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17105
C	0.17130
C	0.17140
C	0.17120
D	0.3965
D	0.3965
G	1.7475
G	1.7485
H	0.10149

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14265
B point 2	0.14270
B point 3	0.14275
B point 4	0.14270
B point 5	0.14275
B point 6	0.14270
B point 7	0.14265
B point 8	0.14260

Statistics

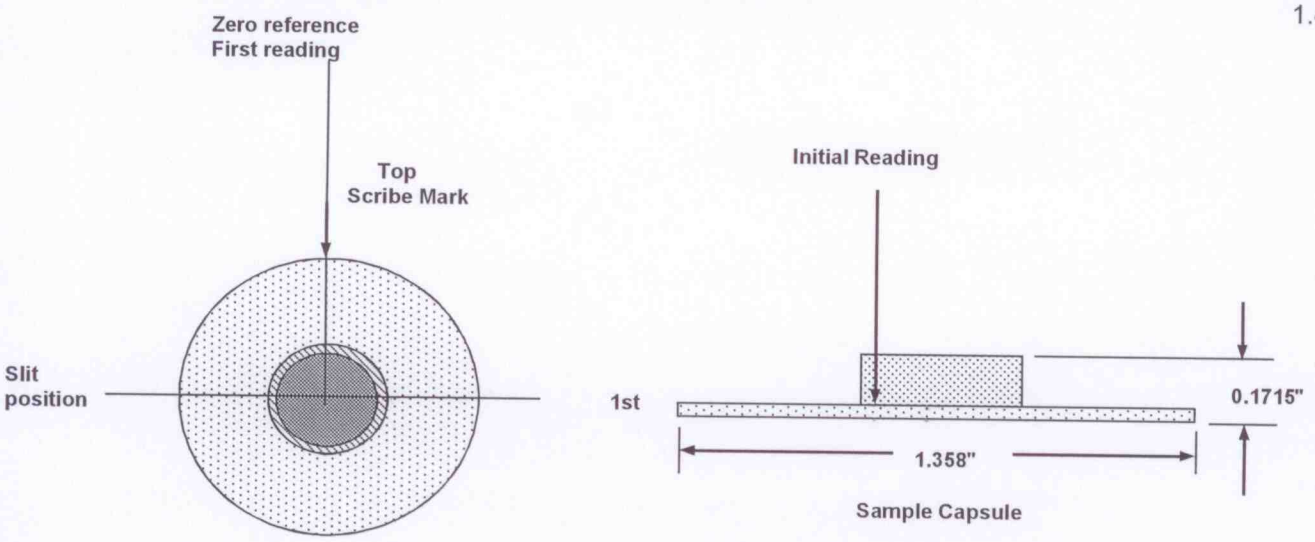
N	8
MAX	0.14275
MIN	0.14260
Range	0.00015
Average	0.14269

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm³	
	CRYSTAL DENSITY:		10.1943	1.17E-03	grams/cm³	
	BULK DENSITY:				grams/cm³	

shot: 1069
SAMPLE CAPSULE **16**
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

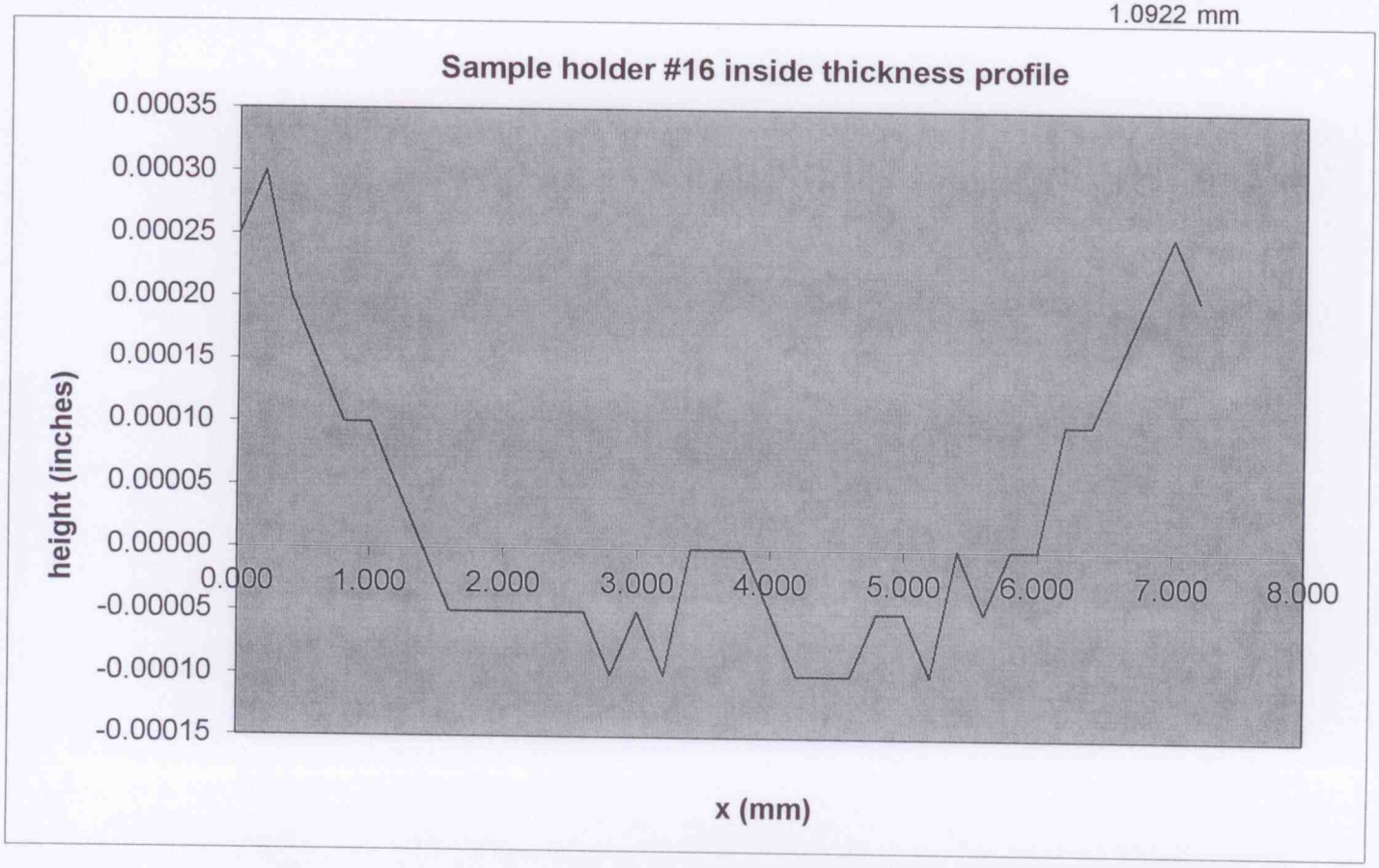
4.683
1.4425



1.338582677

Average thickness reading = 0.00002

Note: The thickness of the reference zero point from the base is = **0.04300** Inches
1.0922 mm



Thickness Profile Inside Measurement Mo #16

Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00025	3.6	south
2	0.200	0.00030	3.40	
3	0.400	0.00020	3.20	
4	0.600	0.00015	3.00	
5	0.800	0.00010	2.80	
6	1.000	0.00010	2.60	
7	1.200	0.00005	2.40	
8	1.400	0.00000	2.20	
9	1.600	-0.00005	2.00	
10	1.800	-0.00005	1.80	
11	2.000	-0.00005	1.60	
12	2.200	-0.00005	1.40	
13	2.400	-0.00005	1.20	
14	2.600	-0.00005	1.00	
15	2.800	-0.00010	0.80	
16	3.000	-0.00005	0.60	
17	3.200	-0.00010	0.40	
18	3.400	0.00000	0.20	
19	3.600	0.00000	0.00	
20	3.800	0.00000	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00010	-0.60	
23	4.400	-0.00010	-0.80	
24	4.600	-0.00010	-1.00	
25	4.800	-0.00005	-1.20	
26	5.000	-0.00005	-1.40	
27	5.200	-0.00010	-1.60	
28	5.400	0.00000	-1.80	
29	5.600	-0.00005	-2.00	
30	5.800	0.00000	-2.20	
31	6.000	0.00000	-2.40	
32	6.200	0.00010	-2.60	
33	6.400	0.00010	-2.80	
34	6.600	0.00015	-3.00	
35	6.800	0.00020	-3.20	
36	7.000	0.00025	-3.40	
37	7.200	0.00020	-3.60	north

SHOT No. ___1069_ _____ tip used: .7mm long/ flat tip

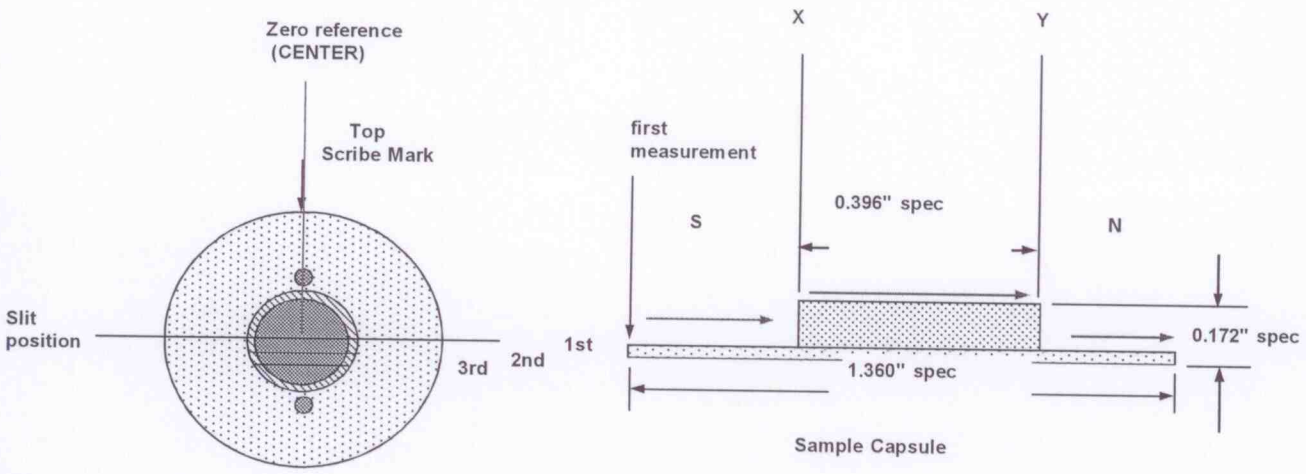
SAMPLE CAPSULE: 16 note: the platform on which the measurement was taken

SAMPLE MATERIAL: An-Di-Hd deviates from flat by +0.013 max.

direction of measurement

1.0525

THICKNESS PROFILE (Not re-polished, but final surface) 1.88



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = 0.00032

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00024

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

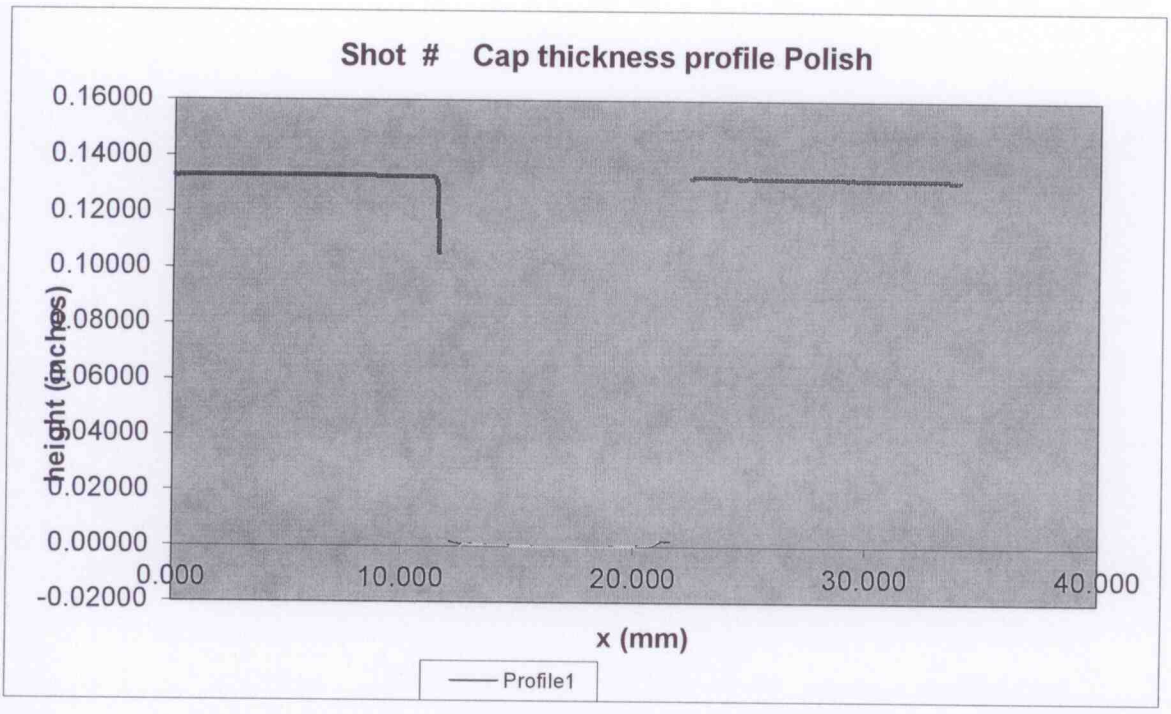
Average thickness reading = 0.00016

Note: Measurement from reference zero point from the base is = **-0.1599** Inches
-4.0602 mm

Average thickness of the driver Plate = -0.0272 Inches
-0.6908 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.16000
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
height (inches)
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Bel

3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

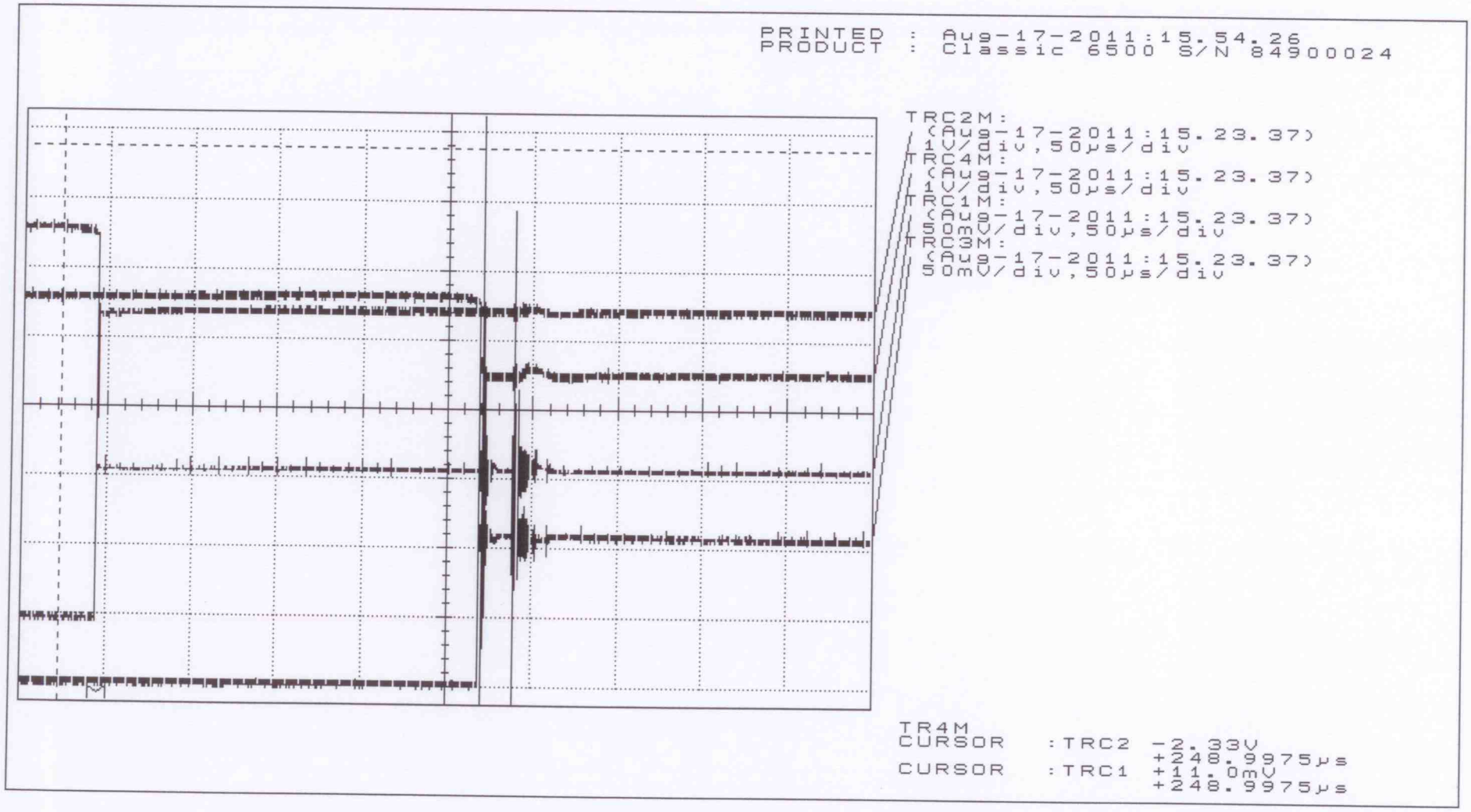
Number	Reading	abs dist.		Number	Reading	abs dist.	
3	Distance			of	Distance		
Reading	mm	mm	South (left side)	Reading	mm	mm	North(right
1	0.000	17.000	0.1332	225	22.400	-5.400	0.1323
2	0.100	16.900	0.1332	226	22.500	-5.500	0.1328
3	0.200	16.800	0.1332	227	22.600	-5.600	0.1328
4	0.300	16.700	0.1332	228	22.700	-5.700	0.1328
5	0.400	16.600	0.1332	229	22.800	-5.800	0.1328
6	0.500	16.500	0.1332	230	22.900	-5.900	0.1328
7	0.600	16.400	0.1332	231	23.000	-6.000	0.1328
8	0.700	16.300	0.1332	232	23.100	-6.100	0.1329
9	0.800	16.200	0.1332	233	23.200	-6.200	0.1328
10	0.900	16.100	0.1332	234	23.300	-6.300	0.1328
11	1.000	16.000	0.1333	235	23.400	-6.400	0.1328
12	1.100	15.900	0.1333	236	23.500	-6.500	0.1328
13	1.200	15.800	0.1332	237	23.600	-6.600	0.1328
14	1.300	15.700	0.1333	238	23.700	-6.700	0.1328
15	1.400	15.600	0.1333	239	23.800	-6.800	0.1328
16	1.500	15.500	0.1333	240	23.900	-6.900	0.1328
17	1.600	15.400	0.1333	241	24.000	-7.000	0.1328
18	1.700	15.300	0.1333	242	24.100	-7.100	0.1328
19	1.800	15.200	0.1333	243	24.200	-7.200	0.1328
20	1.900	15.100	0.1333	244	24.300	-7.300	0.1328
21	2.000	15.000	0.1333	245	24.400	-7.400	0.1327
22	2.100	14.900	0.1333	246	24.500	-7.500	0.1327
23	2.200	14.800	0.1333	247	24.600	-7.600	0.1327
24	2.300	14.700	0.1333	248	24.700	-7.700	0.1327
25	2.400	14.600	0.1333	249	24.800	-7.800	0.1327
26	2.500	14.500	0.1333	250	24.900	-7.900	0.1328
27	2.600	14.400	0.1333	251	25.000	-8.000	0.1327
28	2.700	14.300	0.1333	252	25.100	-8.100	0.1327
29	2.800	14.200	0.1333	253	25.200	-8.200	0.1327
30	2.900	14.100	0.1333	254	25.300	-8.300	0.1327
31	3.000	14.000	0.1333	255	25.400	-8.400	0.1327
32	3.100	13.900	0.1333	256	25.500	-8.500	0.1327
33	3.200	13.800	0.1333	257	25.600	-8.600	0.1327
34	3.300	13.700	0.1333	258	25.700	-8.700	0.1327
35	3.400	13.600	0.1333	259	25.800	-8.800	0.1327
36	3.500	13.500	0.1333	260	25.900	-8.900	0.1327
37	3.600	13.400	0.1333	261	26.000	-9.000	0.1326
38	3.700	13.300	0.1333	262	26.100	-9.100	0.1326
39	3.800	13.200	0.1333	263	26.200	-9.200	0.1326
40	3.900	13.100	0.1333	264	26.300	-9.300	0.1325
41	4.000	13.000	0.1333	265	26.400	-9.400	0.1325
42	4.100	12.900	0.1333	266	26.500	-9.500	0.1324
43	4.200	12.800	0.1333	267	26.600	-9.600	0.1324
44	4.300	12.700	0.1333	268	26.700	-9.700	0.1324
45	4.400	12.600	0.1333	269	26.800	-9.800	0.1324
46	4.500	12.500	0.1334	270	26.900	-9.900	0.1324
47	4.600	12.400	0.1333	271	27.000	-10.000	0.1324
48	4.700	12.300	0.1333	272	27.100	-10.100	0.1324
49	4.800	12.200	0.1334	273	27.200	-10.200	0.1324
50	4.900	12.100	0.1333	274	27.300	-10.300	0.1324
51	5.000	12.000	0.1334	275	27.400	-10.400	0.1324
52	5.100	11.900	0.1334	276	27.500	-10.500	0.1324
53	5.200	11.800	0.1334	277	27.600	-10.600	0.1324

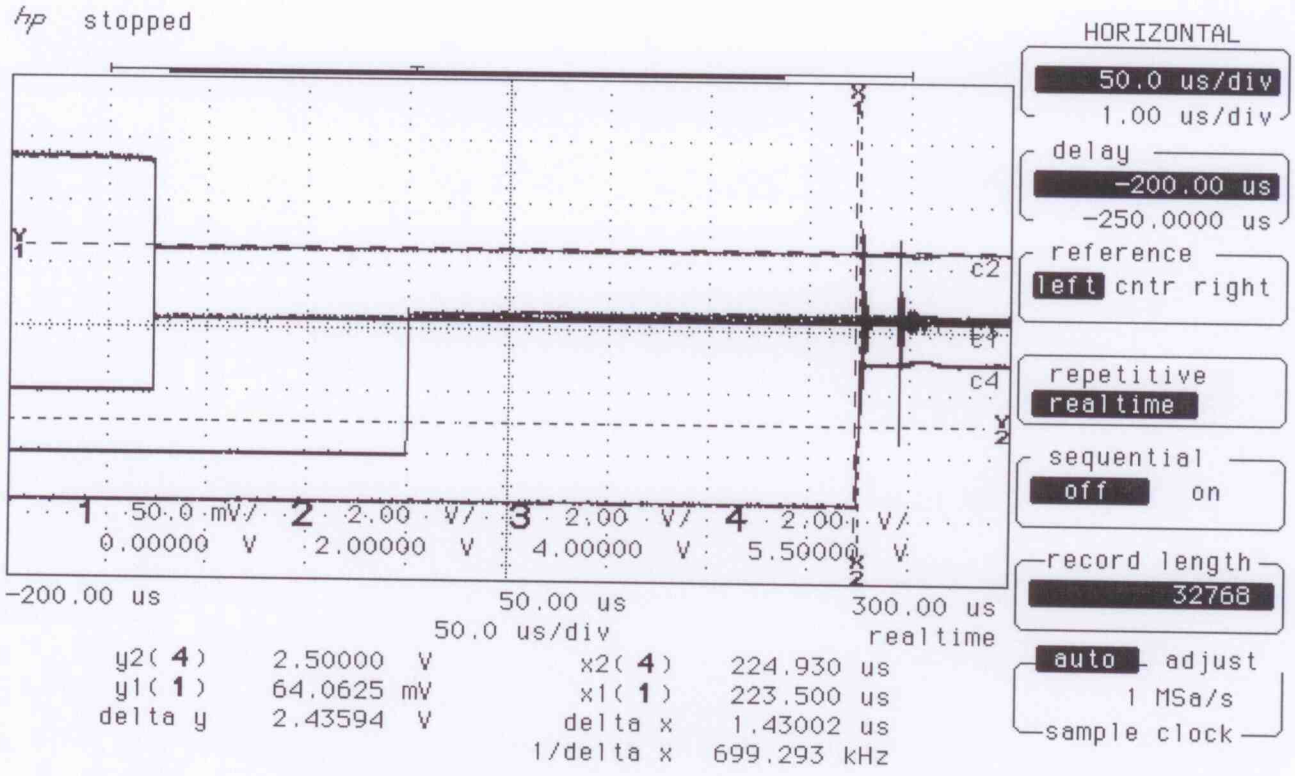
54	5.300	11.700	0.1334	278	27.700	-10.700	0.1324
55	5.400	11.600	0.1333	279	27.800	-10.800	0.1324
56	5.500	11.500	0.1334	280	27.900	-10.900	0.1324
57	5.600	11.400	0.1334	281	28.000	-11.000	0.1323
58	5.700	11.300	0.1334	282	28.100	-11.100	0.1324
59	5.800	11.200	0.1334	283	28.200	-11.200	0.1324
60	5.900	11.100	0.1334	284	28.300	-11.300	0.1324
61	6.000	11.000	0.1334	285	28.400	-11.400	0.1324
62	6.100	10.900	0.1334	286	28.500	-11.500	0.1324
63	6.200	10.800	0.1334	287	28.600	-11.600	0.1323
64	6.300	10.700	0.1334	288	28.700	-11.700	0.1323
65	6.400	10.600	0.1334	289	28.800	-11.800	0.1323
66	6.500	10.500	0.1333	290	28.900	-11.900	0.1323
67	6.600	10.400	0.1334	291	29.000	-12.000	0.1323
68	6.700	10.300	0.1334	292	29.100	-12.100	0.1323
69	6.800	10.200	0.1334	293	29.200	-12.200	0.1323
70	6.900	10.100	0.1333	294	29.300	-12.300	0.1323
71	7.000	10.000	0.1334	295	29.400	-12.400	0.1323
72	7.100	9.900	0.1334	296	29.500	-12.500	0.1322
73	7.200	9.800	0.1334	297	29.600	-12.600	0.1323
74	7.300	9.700	0.1333	298	29.700	-12.700	0.1322
75	7.400	9.600	0.1334	299	29.800	-12.800	0.1322
76	7.500	9.500	0.1334	300	29.900	-12.900	0.1322
77	7.600	9.400	0.1333	301	30.000	-13.000	0.1322
78	7.700	9.300	0.1334	302	30.100	-13.100	0.1322
79	7.800	9.200	0.1333	303	30.200	-13.200	0.1322
80	7.900	9.100	0.1333	304	30.300	-13.300	0.1322
81	8.000	9.000	0.1333	305	30.400	-13.400	0.1322
82	8.100	8.900	0.1333	306	30.500	-13.500	0.1322
83	8.200	8.800	0.1333	307	30.600	-13.600	0.1321
84	8.300	8.700	0.1333	308	30.700	-13.700	0.1322
85	8.400	8.600	0.1333	309	30.800	-13.800	0.1321
86	8.500	8.500	0.1333	310	30.900	-13.900	0.1321
87	8.600	8.400	0.1333	311	31.000	-14.000	0.1321
88	8.700	8.300	0.1332	312	31.100	-14.100	0.1321
89	8.800	8.200	0.1332	313	31.200	-14.200	0.1321
90	8.900	8.100	0.1332	314	31.300	-14.300	0.1321
91	9.000	8.000	0.1332	315	31.400	-14.400	0.1321
92	9.100	7.900	0.1332	316	31.500	-14.500	0.1321
93	9.200	7.800	0.1332	317	31.600	-14.600	0.1320
94	9.300	7.700	0.1332	318	31.700	-14.700	0.1320
95	9.400	7.600	0.1332	319	31.800	-14.800	0.1320
96	9.500	7.500	0.1332	320	31.900	-14.900	0.1320
97	9.600	7.400	0.1332	321	32.000	-15.000	0.1320
98	9.700	7.300	0.1332	322	32.100	-15.100	0.1320
99	9.800	7.200	0.1332	323	32.200	-15.200	0.1320
100	9.900	7.100	0.1332	324	32.300	-15.300	0.1320
101	10.000	7.000	0.1332	325	32.400	-15.400	0.1319
102	10.100	6.900	0.1332	326	32.500	-15.500	0.1320
103	10.200	6.800	0.1331	327	32.600	-15.600	0.1319
104	10.300	6.700	0.1331	328	32.700	-15.700	0.1319
105	10.400	6.600	0.1331	329	32.800	-15.800	0.1319
106	10.500	6.500	0.1330	330	32.900	-15.900	0.1319
107	10.600	6.400	0.1331	331	33.000	-16.000	0.1319
108	10.700	6.300	0.1331	332	33.100	-16.100	0.1319
109	10.800	6.200	0.1331	333	33.200	-16.200	0.1319
110	10.900	6.100	0.1331	334	33.300	-16.300	0.1319
111	11.000	6.000	0.1331	335	33.400	-16.400	0.1318
112	11.100	5.900	0.1330	336	33.500	-16.500	0.1318
113	11.200	5.800	0.1330	337	33.600	-16.600	0.1318
114	11.300	5.700	0.1330	338	33.700	-16.700	0.1318
115	11.400	5.600	0.1323	339	33.800	-16.800	0.1318
116	11.500	5.500	0.1300	340	33.900	-16.900	0.1318
117	11.600	5.400	0.1053	341	34.000	-17.000	0.1317

ɔw the center with 0.100 MM increment

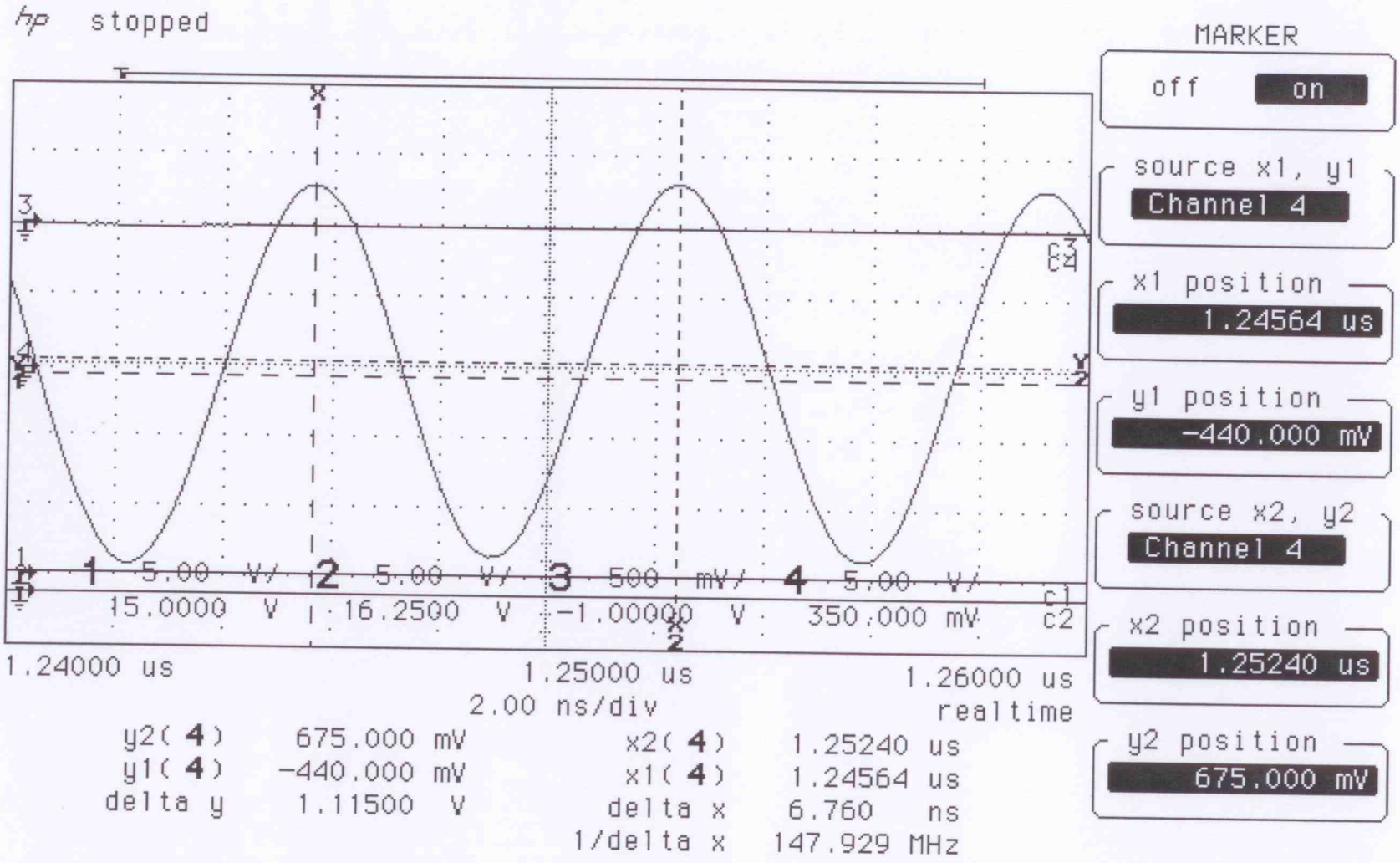
Number of Reading	Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
118	11.700	5.300			
119	11.800	5.200			
120	11.900	5.100			
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	0.00195		
125	12.400	4.600	0.00150		
126	12.500	4.500	0.00115	0.00130	
127	12.600	4.400	0.00095	0.00105	
128	12.700	4.300	0.00090	0.00080	
129	12.800	4.200	0.00075	0.00070	..
130	12.900	4.100	0.00075	0.00075	0.00075
131	13.000	4.000	0.00075	0.00065	0.00065
132	13.100	3.900	0.00070	0.00065	0.00065
133	13.200	3.800	0.00065	0.00060	0.00060
134	13.300	3.700	0.00065	0.00055	0.00055
135	13.400	3.600	0.00060	0.00055	0.00055
136	13.500	3.500	0.00060	0.00050	0.00050
137	13.600	3.400	0.00055	0.00045	0.00045
138	13.700	3.300	0.00050	0.00045	0.00045
139	13.800	3.200	0.00045	0.00045	0.00045
140	13.900	3.100	0.00045	0.00040	0.00040
141	14.000	3.000	0.00040	0.00040	0.00040
142	14.100	2.900	0.00040	0.00035	0.00035
143	14.200	2.800	0.00035	0.00035	0.00035
144	14.300	2.700	0.00035	0.00030	0.00030
145	14.400	2.600	0.00030	0.00030	0.00030
146	14.500	2.500	0.00030	0.00025	0.00025
147	14.600	2.400	0.00025	0.00020	0.00020
148	14.700	2.300	0.00020	0.00020	0.00020
149	14.800	2.200	0.00020	0.00020	0.00020
150	14.900	2.100	0.00020	0.00015	0.00015
151	15.000	2.000	0.00015	0.00015	0.00015
152	15.100	1.900	0.00015	0.00010	0.00010
153	15.200	1.800	0.00010	0.00010	0.00010
154	15.300	1.700	0.00010	0.00010	0.00010
155	15.400	1.600	0.00010	0.00005	0.00005
156	15.500	1.500	0.00010	0.00005	0.00005
157	15.600	1.400	0.00005	0.00005	0.00005
158	15.700	1.300	0.00005	0.00000	0.00000
159	15.800	1.200	0.00005	0.00000	0.00000
160	15.900	1.100	0.00000	-0.00005	-0.00005
161	16.000	1.000	-0.00005	-0.00005	-0.00005
162	16.100	0.900	0.00000	0.00000	0.00000
163	16.200	0.800	-0.00005	-0.00005	-0.00005
164	16.300	0.700	-0.00005	-0.00010	-0.00010
165	16.400	0.600	-0.00005	-0.00010	-0.00010
166	16.500	0.500	-0.00010	-0.00010	-0.00010
167	16.600	0.400	-0.00010	-0.00010	-0.00010
168	16.700	0.300	-0.00010	-0.00010	-0.00010
169	16.800	0.200	-0.00010	-0.00015	-0.00015
170	16.900	0.100	-0.00010	-0.00010	-0.00010

171	17.000	0.000	0.00000	-0.00015	-0.00015
172	17.100	-0.100	-0.00010	-0.00015	-0.00015
173	17.200	-0.200	-0.00010	-0.00010	-0.00010
174	17.300	-0.300	-0.00010	-0.00010	-0.00010
175	17.400	-0.400	-0.00010	-0.00015	-0.00015
176	17.500	-0.500	-0.00010	-0.00015	-0.00015
177	17.600	-0.600	-0.00010	-0.00010	-0.00010
178	17.700	-0.700	-0.00010	-0.00015	-0.00015
179	17.800	-0.800	-0.00010	-0.00015	-0.00015
180	17.900	-0.900	-0.00010	-0.00015	-0.00015
181	18.000	-1.000	-0.00010	-0.00010	-0.00010
182	18.100	-1.100	-0.00005	-0.00015	-0.00015
183	18.200	-1.200	-0.00010	-0.00010	-0.00010
184	18.300	-1.300	-0.00010	-0.00010	-0.00010
185	18.400	-1.400	-0.00010	-0.00010	-0.00010
186	18.500	-1.500	-0.00005	-0.00010	-0.00010
187	18.600	-1.600	-0.00005	-0.00010	-0.00010
188	18.700	-1.700	-0.00005	-0.00010	-0.00010
189	18.800	-1.800	-0.00005	-0.00005	-0.00005
190	18.900	-1.900	-0.00005	-0.00010	-0.00010
191	19.000	-2.000	-0.00005	-0.00010	-0.00010
192	19.100	-2.100	0.00000	-0.00005	-0.00005
193	19.200	-2.200	0.00000	-0.00005	-0.00005
194	19.300	-2.300	0.00000	-0.00005	-0.00005
195	19.400	-2.400	0.00000	0.00000	0.00000
196	19.500	-2.500	0.00005	0.00000	0.00000
197	19.600	-2.600	0.00005	0.00005	0.00005
198	19.700	-2.700	0.00010	0.00005	0.00005
199	19.800	-2.800	0.00010	0.00005	0.00005
200	19.900	-2.900	0.00010	0.00010	0.00010
201	20.000	-3.000	0.00010	0.00010	0.00010
202	20.100	-3.100	0.00015	0.00010	0.00010
203	20.200	-3.200	0.00015	0.00010	0.00010
204	20.300	-3.300	0.00020	0.00010	0.00010
205	20.400	-3.400	0.00020	0.00020	0.00020
206	20.500	-3.500	0.00020	0.00025	0.00025
207	20.600	-3.600	0.00025	0.00030	0.00030
208	20.700	-3.700	0.00030	0.00030	0.00030
209	20.800	-3.800	0.00030	0.00035	0.00035
210	20.900	-3.900	0.00040	0.00035	0.00035
211	21.000	-4.000	0.00040	0.00045	0.00045
212	21.100	-4.100	0.00060	0.00100	0.00100
213	21.200	-4.200	0.00095	0.00155	0.00155
214	21.300	-4.300	0.00150	0.00205	0.00205
215	21.400	-4.400	0.00180	0.00190	
216	21.500	-4.500	0.00190	0.00175	
217	21.600	-4.600	0.00190	0.00175	
218	21.700	-4.700	0.00195		
219	21.800	-4.800	0.00190		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			


PRINTED : Aug-17-2011:15.54.26
PRODUCT : Classic 6500 S/N 84900024
TRC2M:
(Aug-17-2011:15.23.37)
1V/div,50µs/div
TRC4M:
(Aug-17-2011:15.23.37)
1V/div,50µs/div
TRC1M:
(Aug-17-2011:15.23.37)
50mV/div,50µs/div
TRC3M:
(Aug-17-2011:15.23.37)
50mV/div,50µs/div
TR4M
CURSOR :TRC2 -2.33V
+248.9975µs
CURSOR :TRC1 +11.0mV
+248.9975µs

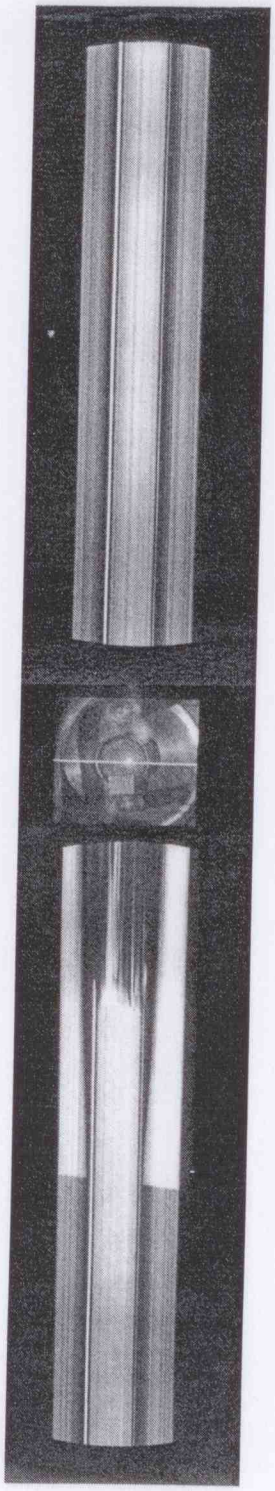

hp stopped
HORIZONTAL
50.0 us/div
1.00 us/div
delay
-200.00 us
-250.0000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
1 MSa/s
sample clock
c2
c1
c4
1 50.0 mV/ 0.00000 V
2 2.00 V/ 2.00000 V
3 2.00 V/ 4.00000 V
4 2.00 V/ 5.50000 V
-200.00 us
50.00 us
50.0 us/div
300.00 us
realtime
y2(4) 2.50000 V
y1(1) 64.0625 mV
delta y 2.43594 V
x2(4) 224.930 us
x1(1) 223.500 us
delta x 1.43002 us
1/delta x 699.293 kHz

CAL1069

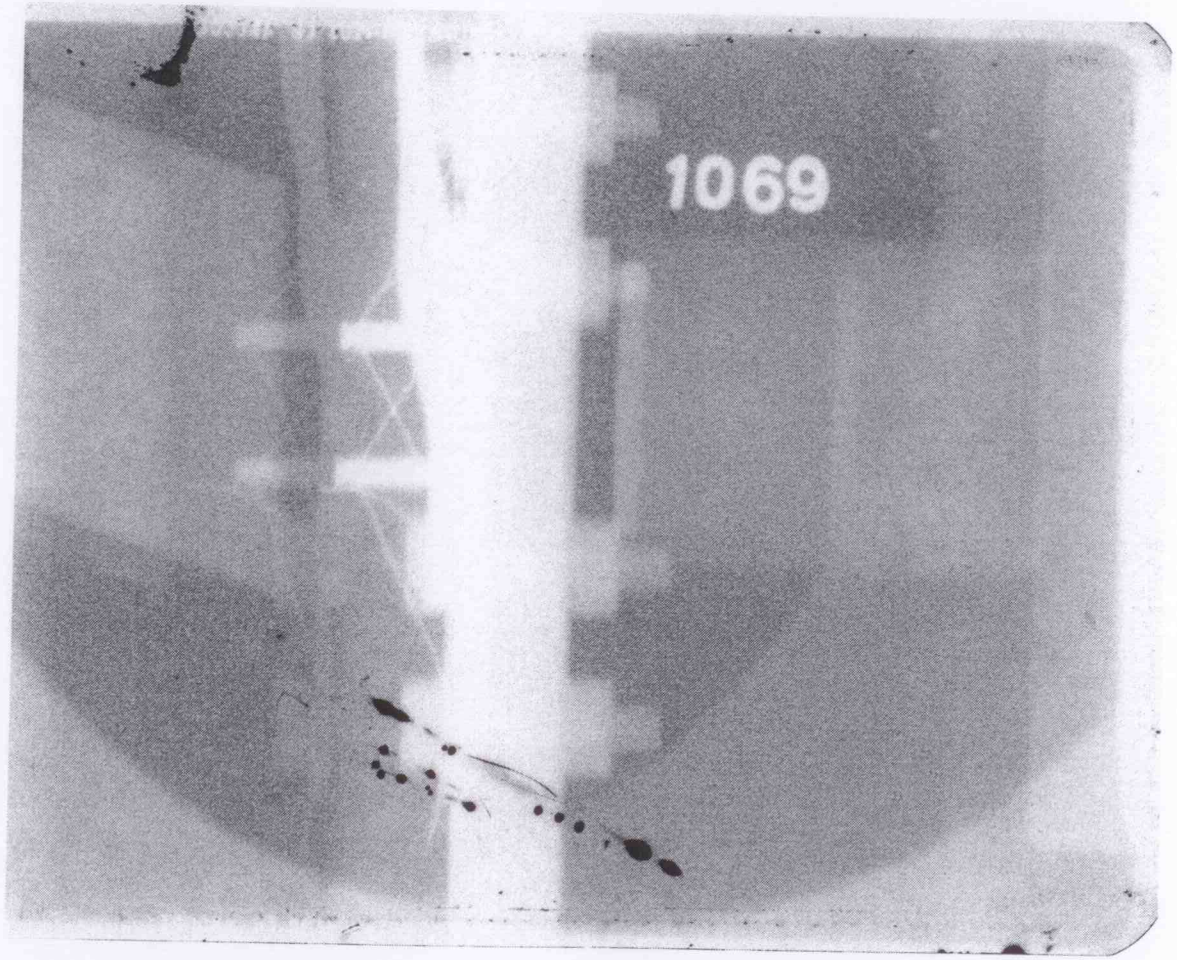

stopped
MARKER
off
on
source x1, y1
Channel 4
x1 position
1.24564 us
y1 position
-440.000 mV
source x2, y2
Channel 4
x2 position
1.25240 us
y2 position
675.000 mV
1 5.00 V/
2 5.00 V/
3 500 mV/
4 5.00 V/
15.0000 V
16.2500 V
-1.00000 V
350.000 mV
1.24000 us
1.25000 us
2.00 ns/div
1.26000 us
realtime
y2(4) 675.000 mV
y1(4) -440.000 mV
delta y 1.11500 V
x2(4) 1.25240 us
x1(4) 1.24564 us
delta x 6.760 ns
1/delta x 147.929 MHz

~~Unsupported Personality. PCR~~

8f



SHOT 1069


1069

40 mm GUN DATA SHEET

Shot No. 1070 Date 8-22-11

Target:

Sample Material: Anorthite - Hedenbergite Mix (Sample #20)

Type of Measurement: Pre-heated EOS 1400°C

Expected Velocity: 2.00 km/sec.

Projectile:

Flyer Material: Mo (#4) Thickness: 0.09991 in. Weight: 20.208 gms.

Projectile Material: LEXAN Length: 2.4955 in. Dia: 1.560 / 1.567 in.

Weight: 97.2733 gms. Corrected Weight: 93.2733 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle

Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400

Main Charge Weight: 270.49 gms. Powder Type: IMR4350 C/M: 2.9

Laser Distances:

Beam I to Muzzle: 68.5 / 68.5 cm. Co-axial Pin Height: — in.

Beam II to Muzzle: 43.15 / 43.2 cm. Shim Thickness: — in.

Beam III to Muzzle: 2.1 / 2.1 cm. Total Height: — cm.

Beam III to Target: 51.437 / 51.397 mm. Corrected III to Target Distance: — cm.

51.417

Estimated Times:

Beam I to II: 126.8 µsec.

Beam II to III: 226.3 µsec.

Beam III to Target: 25.71 µsec.

Actual Beam Distances:

Beam I to II: 0.2535 m.

Beam II to III: 0.4525 m.

Beam III to Target: ~~51.417~~ m. 0.051417

Fudge: 0.048989

Delays:

Xenon Lamp Delay: −6.127 µsec. Lamp Triggered by Laser No.: 3

X-ray 1 to 2 Interval: 17.715 µsec. Camera dial 270 for 2000 ns streak

Notes:

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: 17.628 µsec.
UDC 225.75 µsec
Counter 6 X-ray interval 17.430 µsec
Tank/Pump Pressure: 100/105 µm.

HP6-1	30.60 ns*	HP5-1	-128.364 µsec	GS7-1	23.891 µsec
HP6-2	17.6626 µsec	HP5-2	-128.294 µsec	GS7-2	~~24.038 ns*~~
HP6-3	23.240 µsec	HP5-3	0.00 ns*	GS7-3	249.707 µsec
HP6-4	25.440 µsec	HP5-4	225.832 µsec	GS7-4	249.867 µsec

Measured Shot Velocities:

Velocity, X-ray:_____ km/sec.

Backup Velocity, X-ray : _____ km/s
UDC : 2004.46 km/sec

SETUP: SHOT for scopes

HP6

trig : Ch1 50V+ - second hump (above 30V for 30ns) –lvl 10V+ 5
Ch2 50V+ - second hump (above 30V for 30ns) 5
Ch3 cam monitor --(-1.75V) -- set 500mV/
Ch4 photodiode—peak brightness—set 200mV/

TOTAL TIME (from wksht): 25 → ~65 us
Set time ~~65~~ 131 us (~~200~~ ns/div)
Delay from trig -40 us (need: 0)

HP5

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V 2V
Ch1 laser1 analog -- downgoing 150mV 50mV/div
Ch2 laser 1 TTL, 4V -- level 2.5V+ 2V
Ch4 laser 3 4V TTL -- jog in sig ~2.5V 2V

TOTAL TIME (from wksht): 353 us
Set time 655 us (1µs ~~ns~~/div)
Delay from trig -250 us (need: ~~-327~~)

GS7

trig : Ch2 laser 2 TTL -- 4V+
Ch1 laser 2 analog -- -150mV
Ch3 laser 3 analog -- -150mV
Ch4 laser 3 TTL –4V+

TOTAL TIME (from wksht): 228 us
Set time 500 us (M: 50 us) ¡check!
Pretrigger view 9 % ¡ 50mV/V 50mV 7V

40 mm hot EOS shot Nominal Timeline Preshot

V	2000
cable time	75
photodiode intrinsic delays	[redacted]
UDC extra count lag	118
pulse translator delay	150
X-ray 1 program delay	0
X-ray 2 program delay	17715.375
X-ray 1 pulser delay	426
X-ray 2 pulser delay	887
amp trigger to peak bright	[redacted]
HV3 program delay	-6127
Camera intrinsic delay	107
Streak duration	2000
d dead streak before driver	750

2140 2140

971 X-ray 1 delay amp intrinsic

1216 X-ray 2 delay amp intrinsic

Laser1-Laser2 distance	0.2535
Laser2-Laser3 distance	0.4525
Laser3-target distance	0.051417
Laser3-target fudge	0.048989
Laser3-Xray2 % of Laser3-target	75
Us(Mo)	6231.07346
driver thickness	0.00069088
sample thickness	0.00254
cap thickness	0.00078511
estimated sample+cover time	556.080109

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-126750	-0.2535		Laser 1 actual interrupt		HP5-1
-126550	-0.2531		Laser 1 TTL out		
-126475	-0.25295		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
200	0.0004		Laser 2 TTL out (shot)		GS7-2 & Trig
-1865	-0.00373		Magnet Sim 1 analog (sim)	HP5-1	
275	0.00055		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
226250	0.4525		Laser 3 actual interrupt		GS7-3
226450	0.4529		Laser 3 TTL out		GS7-4
224385	0.44877		Magnet Sim 2 analog (sim)	HP5-2	
226525	0.45305		Laser 3 TTL at UDC (start down-count) and pulse transla	HP5-4, UDC stop	HP5-4, UDC stop
226750	0.4535		Pulse translator out reaches X-ray delay amps 1 & 2		
227721	0.455442		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
228147	0.456294		X-ray 1 fires		
228222	0.456444		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
245681	0.49136275		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
246568	0.49106275		X-ray 2 fires		
246643	0.49328675		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
245010	0.49002075		HV3 out to lamp		
251137	0.50227475		UDC zero time, HV1 out to camera		
251212	0.50242475		Trigger at camera		
251319	0.50263875		Begin Streak		
251394	0.50278875		Camera Monitor reaches control lab	HP6-3	HP6-3
252287	0.50457475		Lamp Peak Bright	HP6-4	HP6-4
251959	0.503917	0	IMPACT		
252069		0.00069088	Driver arrival on streak	Driver cutoff on streak	750
252625		0.004155856	Sample cutoff on streak	Sample cutoff on sreak	1306
253319		0.008479722	End Streak		

	rho0	Co	s			
Cold Mo	10206	5033	1.28946405			
Hot Mo	9937	4918.5831	1.28837124	1407		
Liquid An-Hd	[redacted]					

				up	P	Us
driver	357.7250824	-152883839	1.55375E+11	1018.72063	63.0773243	6231.07346
sample	8420.397546	-108768913	1.52727E+11	1603.09736	23.6442347	5288.89719
cap	-8420.39755	-84700082	69812016265	765.908141	44.9446644	5905.35712

Cold Mo	10206	5033	1.28946405	
Hot Mo	9961.5	4927.8728	1.288702471	1300
	9937	4918.5831	1.28837124	1407
	9913	4908.7717	1.2882417	1508
	9875	4893.13	1.28807834	1659

	SIM	SHOT		
HP5 1	-2140	-127025		
HP5 2	224110	-126750		
HP5 3	0	0		
HP5 4	226250	226250	353275	228390
UDC upcount:	226250	226250		
HP6 1	0	0		
HP6 2	18421	18421		
HP6 3	23172	23172		
HP6 4	24065	24065		
GS7 1		-275		
GS7 2		0		
GS7 3		226050		
GS7 4		226250		
Counter 4b:	18421	18421		
Counter 6:	17960	17960		

40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: 17.913 µsec.

UDC 226.86 µsec

Counter 6 X-ray interval 17.561 µsec

HP6-1 32.000 ns*

HP6-2 17.8752 µsec

HP6-3 23.376 µsec

HP6-4 25.260 µsec

HP5-1 −2.120 µsec

HP5-2 224.820 µsec

HP5-3 20.00 ns*

HP5-4 226.960 µsec

Measured Shot Velocities:

UDC : 1994.67 m/sec

Cal frequency 147.9850 MHz

SETUP: SIM for scopes

HP6

trig : Ch1 xray 1 50V+

- second hump (above 30V for 30ns) –lvl 10V+

Ch2 xray2 50V+ - second hump (above 30V for 30ns)

Ch3 cam monitor -- -1.75V -- set 500mV

Ch4 photodiode—peak brightness—set 200mV

TOTAL TIME (from wksht): 25 us

Set time 65 us (100 ns/div)

Delay from trig −40 us (need: 0µs)

HP5

trig Ch3 laser 2 5V TTL -- jog in sig ~2.5V

Ch1 Mag sim 1 -- zero crossing (6V)

Ch2 Mag sim 2

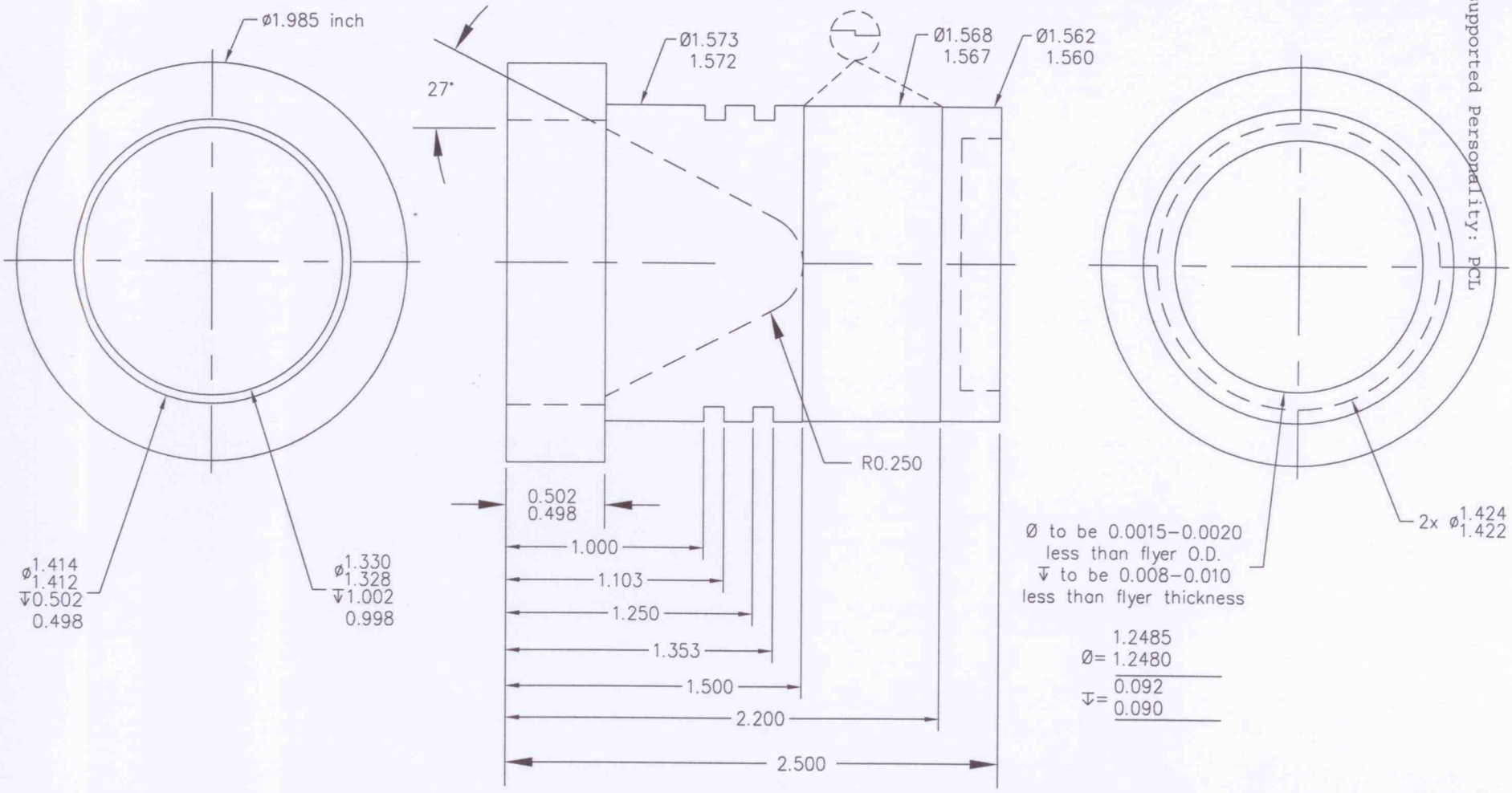
Ch4 laser 3 5V TTL -- jog in sig ~2.5V

TOTAL TIME (from wksht) 228 us

Set time 655 us (1 µs/div)

Delay from trig −40 us (need: −2 ns)

1070



Note: Use only Westlake Plastics
Zelux M Polycarbonate

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

FINISH: 16

DRAWN	M. Long	DATE 3/20/09
ENGINEER		DATE
APPROVED		DATE

MATERIAL: Polycarbonate

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

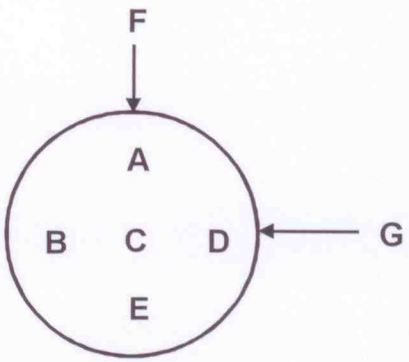
TITLE: 40 mm Propellant Projectile Sabot

SCALE	SHEET		DRAWING NUMBER
2:1	1 of 2	B	40mm-048C

SHOT No. **1070**

FLYER PLATE MATERIAL: **Mo #4** 6/28/2011

Measurement done by: Russ



DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.09990	F	1.25000
A	0.09990	F	1.25000
B	0.10005	G	1.25000
B	0.10010	G	1.25000
C	0.10000		
C	0.09990		
D	0.09980		
D	0.09965		
E	0.09985		
E	0.09990		

Statistic for thickness

N	10
MAX	0.10010
MIN	0.09965
Range	0.00045
MEAN	0.099914286
	2.537822857
STDEV	0.000154689

Statistic for Diameter (F-G)

N	4	
MAX	1.25000	
MIN	1.25000	
Range	0.00000	
MEAN	1.2500000	inch
	31.7500000	mm
STDEV	0	

	Sample in Air	Crystal Density	
1	20.20803	10.109	
2	20.20809	10.115	
3	20.20760	10.113	

Density measurement calculated on the Mettler Toledo XS250 Balance

20.20791

THICKNESS	0.099914286	±	in
FLATNESS:	0.00045	in.	
VOLUME:	2.0093	3.93E-04	cm^3
CRYSTAL DENSITY:	10.1123	3.06E-03	$grams/cm^3$
BULK DENSITY:	10.0573	4.75E-04	$grams/cm^3$
DENSITIES CHECKED BY: _____ on _____			
MEASUREMENT CHECKED E	Russ	6/28/2011	

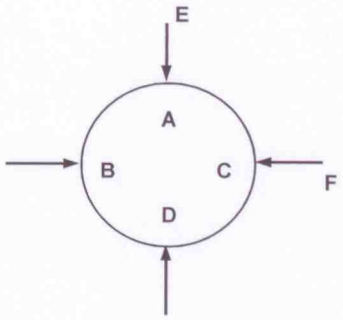
SHOT No. ____1070_____

LGG Moly Capsule Cap 11/18/2010

SAMPLE MATERIAL: Mo 20

Post polish

Thickness Measurement	
A	0.02950
A	0.02955
B	0.02945
B	0.02955
C	0.02960
C	0.02955
D	0.02960
D	0.02960



Diameter Measurement	
E	0.35400
E	0.35400
F	0.35350
F	0.35400
AVE	0.35388
Radius	0.1769

Statistic for thickness	
N	8
MAX	0.02960
MIN	0.0295
Range	0.00015
MEAN	0.02955
STDEV	5.34522E-05

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.353875
STDEV	0.00025

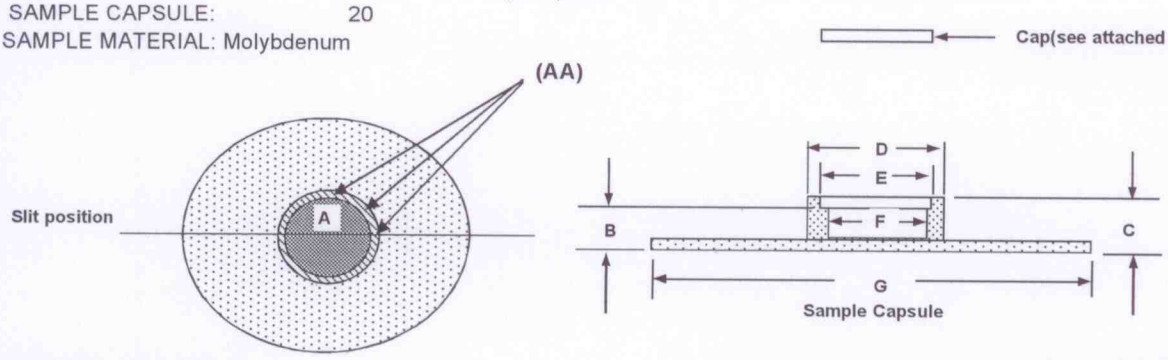
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.02955	±	mm	
	FLATNESS:		0.00015			
	VOLUME:		0.0476		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	grams/cm^3	
	BULK DENSITY:		10.4409		grams/cm^3	

SHOT No.: 1070 post polish 11/18/2010

SAMPLE CAPSULE: 20

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04150
A	0.04165
A	0.04165
A	0.04170
Avg	0.04163

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17210
C	0.17215
C	0.17235
C	0.17205
D	0.3950
D	0.3955

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14320
B point 2	0.14315
B point 3	0.14315
B point 4	0.14310
B point 5	0.14310
B point 6	0.14310
B point 7	0.14315
B point 8	0.14315

Statistics

N	8
MAX	0.14320
MIN	0.14310
Range	0.00010
Average	0.14314

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3540
F	0.3145
F	0.3150
G	1.7480
G	1.7490
H	0.10151

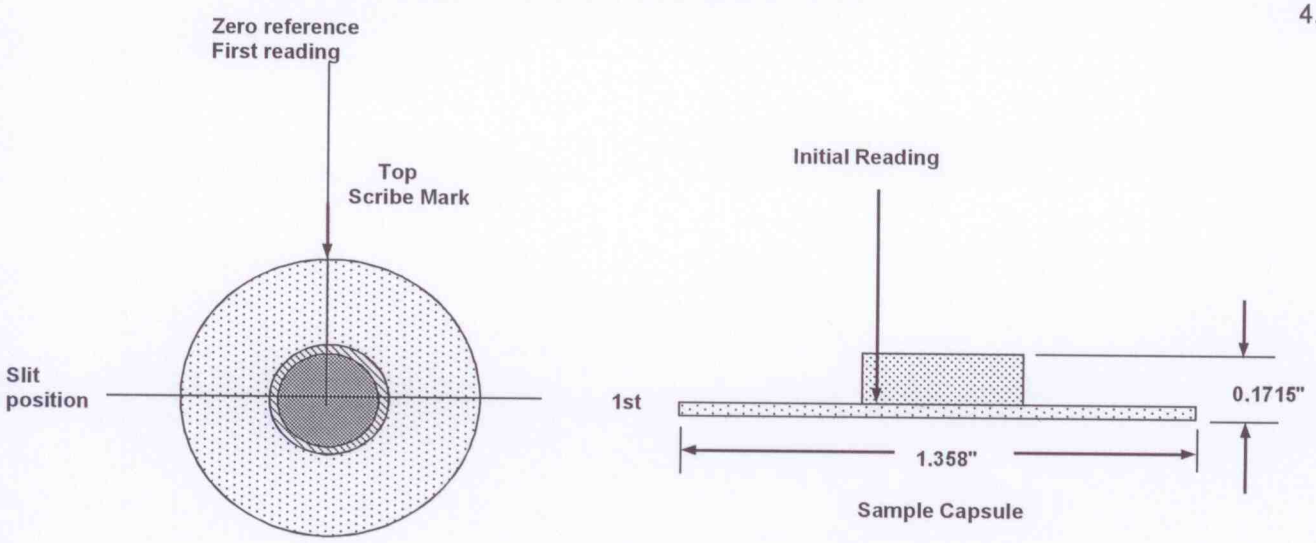
MEASUREMENT BY:		Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SAMPLE CAPSULE **20**
SAMPLE MATERIAL **Molybdenum**

Thickness Measurement of the Sampl

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

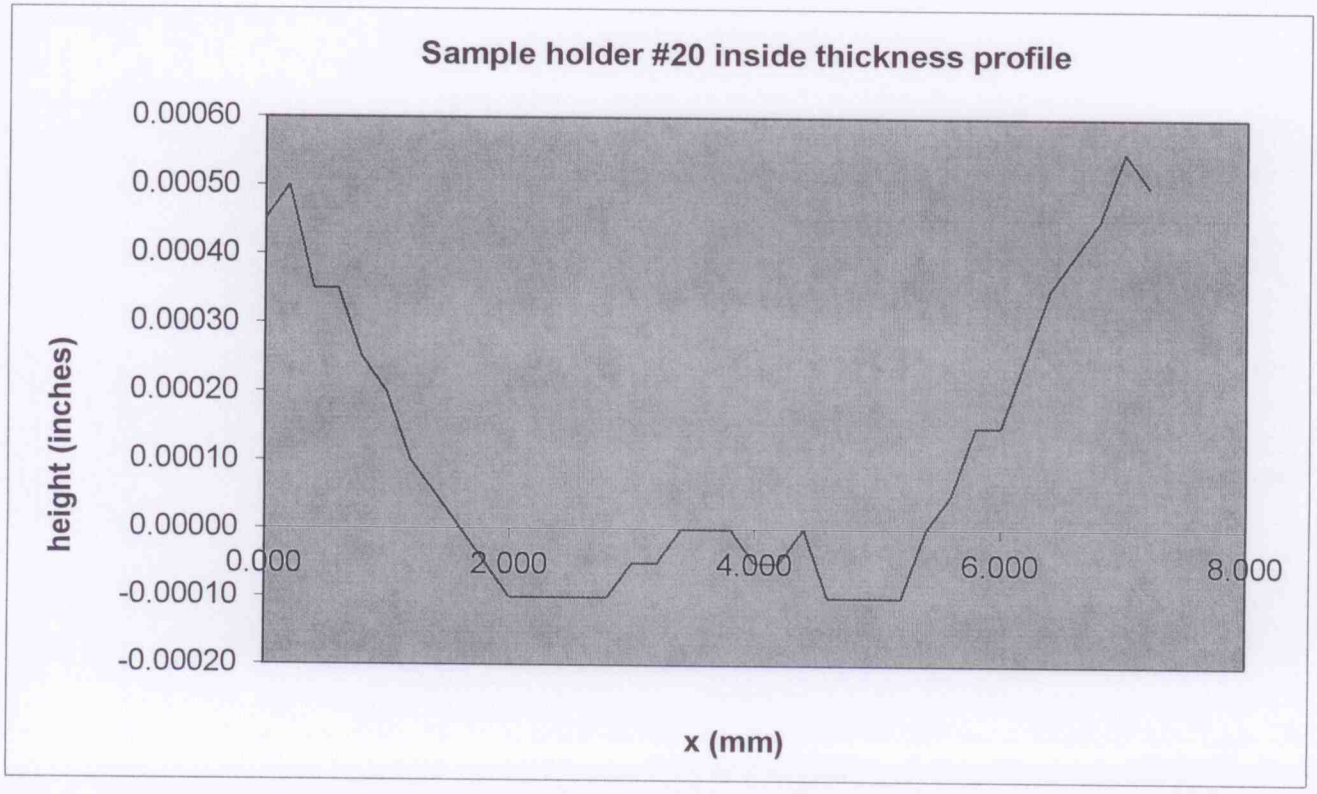
4.683
4.623



1.338582677

Average thickness reading = 0.00010

Note: The thickness of the reference zero point from the base is = **0.04480** Inches
1.13792 mm



e Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00045	3.6	south
2	0.200	0.00050	3.40	
3	0.400	0.00035	3.20	
4	0.600	0.00035	3.00	
5	0.800	0.00025	2.80	
6	1.000	0.00020	2.60	
7	1.200	0.00010	2.40	
8	1.400	0.00005	2.20	
9	1.600	0.00000	2.00	
10	1.800	-0.00005	1.80	
11	2.000	-0.00010	1.60	
12	2.200	-0.00010	1.40	
13	2.400	-0.00010	1.20	
14	2.600	-0.00010	1.00	
15	2.800	-0.00010	0.80	
16	3.000	-0.00005	0.60	
17	3.200	-0.00005	0.40	
18	3.400	0.00000	0.20	
19	3.600	0.00000	0.00	
20	3.800	0.00000	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00005	-0.60	
23	4.400	0.00000	-0.80	
24	4.600	-0.00010	-1.00	
25	4.800	-0.00010	-1.20	
26	5.000	-0.00010	-1.40	
27	5.200	-0.00010	-1.60	
28	5.400	0.00000	-1.80	
29	5.600	0.00005	-2.00	
30	5.800	0.00015	-2.20	
31	6.000	0.00015	-2.40	
32	6.200	0.00025	-2.60	
33	6.400	0.00035	-2.80	
34	6.600	0.00040	-3.00	
35	6.800	0.00045	-3.20	
36	7.000	0.00055	-3.40	
37	7.200	0.00050	-3.60	north

SHOT No. ___1070_ _____ tip used: .7mm long/ flat tip

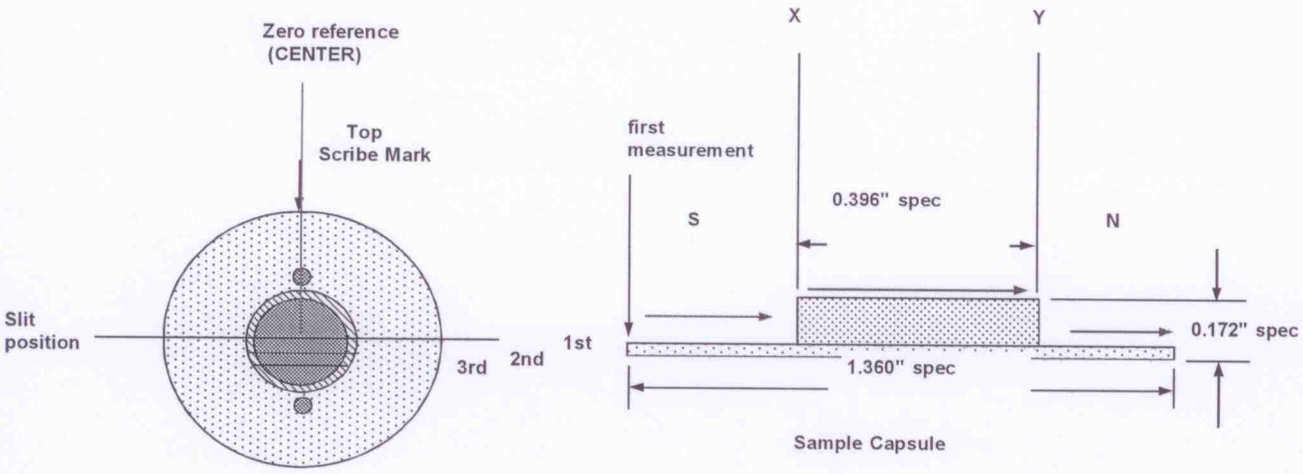
SAMPLE CAPSULE: 20 note: the platform on which the measurement was taken

SAMPLE MATERIAL: An-Hd deviates from flat by +0.013 max.

direction of measurement

2.4

THICKNESS PROFILE (Not re-polished, but final surface) 1.835



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = 0.00108

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00102

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

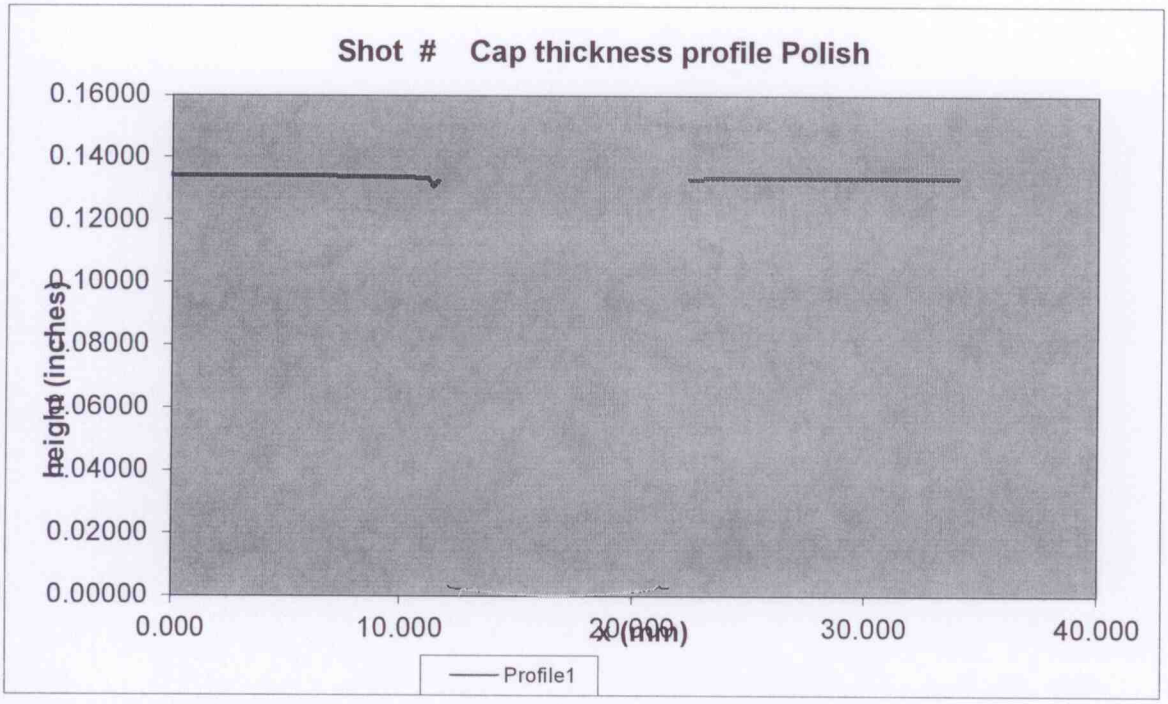
Average thickness reading = 0.00090

Note: Measurement from reference zero point from the base is = **-0.1771** Inches
-4.4971 mm

Average thickness of the driver Plate = -0.0433 Inches
-1.0991 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.16000
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
Height (inches)
0.000
10.000
20.000
30.000
40.000
X (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Bel

3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

Number	Reading	abs dist.		Number	Reading	abs dist.	
3	Distance			of	Distance		
Reading	mm	mm	South (left side)	Reading	mm	mm	North(right
1	0.000	17.000	0.1344	225	22.400	-5.400	0.1332
2	0.100	16.900	0.1344	226	22.500	-5.500	0.1331
3	0.200	16.800	0.1344	227	22.600	-5.600	0.1332
4	0.300	16.700	0.1344	228	22.700	-5.700	0.1332
5	0.400	16.600	0.1344	229	22.800	-5.800	0.1333
6	0.500	16.500	0.1344	230	22.900	-5.900	0.1333
7	0.600	16.400	0.1344	231	23.000	-6.000	0.1333
8	0.700	16.300	0.1344	232	23.100	-6.100	0.1334
9	0.800	16.200	0.1344	233	23.200	-6.200	0.1334
10	0.900	16.100	0.1344	234	23.300	-6.300	0.1334
11	1.000	16.000	0.1344	235	23.400	-6.400	0.1334
12	1.100	15.900	0.1344	236	23.500	-6.500	0.1334
13	1.200	15.800	0.1344	237	23.600	-6.600	0.1334
14	1.300	15.700	0.1344	238	23.700	-6.700	0.1334
15	1.400	15.600	0.1344	239	23.800	-6.800	0.1335
16	1.500	15.500	0.1344	240	23.900	-6.900	0.1334
17	1.600	15.400	0.1344	241	24.000	-7.000	0.1334
18	1.700	15.300	0.1344	242	24.100	-7.100	0.1335
19	1.800	15.200	0.1344	243	24.200	-7.200	0.1335
20	1.900	15.100	0.1344	244	24.300	-7.300	0.1335
21	2.000	15.000	0.1344	245	24.400	-7.400	0.1335
22	2.100	14.900	0.1344	246	24.500	-7.500	0.1335
23	2.200	14.800	0.1344	247	24.600	-7.600	0.1335
24	2.300	14.700	0.1344	248	24.700	-7.700	0.1335
25	2.400	14.600	0.1344	249	24.800	-7.800	0.1335
26	2.500	14.500	0.1344	250	24.900	-7.900	0.1335
27	2.600	14.400	0.1344	251	25.000	-8.000	0.1335
28	2.700	14.300	0.1344	252	25.100	-8.100	0.1335
29	2.800	14.200	0.1344	253	25.200	-8.200	0.1335
30	2.900	14.100	0.1344	254	25.300	-8.300	0.1335
31	3.000	14.000	0.1344	255	25.400	-8.400	0.1335
32	3.100	13.900	0.1344	256	25.500	-8.500	0.1335
33	3.200	13.800	0.1344	257	25.600	-8.600	0.1335
34	3.300	13.700	0.1344	258	25.700	-8.700	0.1335
35	3.400	13.600	0.1344	259	25.800	-8.800	0.1335
36	3.500	13.500	0.1344	260	25.900	-8.900	0.1335
37	3.600	13.400	0.1344	261	26.000	-9.000	0.1335
38	3.700	13.300	0.1344	262	26.100	-9.100	0.1335
39	3.800	13.200	0.1344	263	26.200	-9.200	0.1335
40	3.900	13.100	0.1343	264	26.300	-9.300	0.1335
41	4.000	13.000	0.1343	265	26.400	-9.400	0.1335
42	4.100	12.900	0.1344	266	26.500	-9.500	0.1335
43	4.200	12.800	0.1344	267	26.600	-9.600	0.1335
44	4.300	12.700	0.1344	268	26.700	-9.700	0.1335
45	4.400	12.600	0.1343	269	26.800	-9.800	0.1336
46	4.500	12.500	0.1343	270	26.900	-9.900	0.1336
47	4.600	12.400	0.1343	271	27.000	-10.000	0.1336
48	4.700	12.300	0.1343	272	27.100	-10.100	0.1336
49	4.800	12.200	0.1343	273	27.200	-10.200	0.1336
50	4.900	12.100	0.1343	274	27.300	-10.300	0.1336
51	5.000	12.000	0.1343	275	27.400	-10.400	0.1336
52	5.100	11.900	0.1343	276	27.500	-10.500	0.1336
53	5.200	11.800	0.1343	277	27.600	-10.600	0.1336

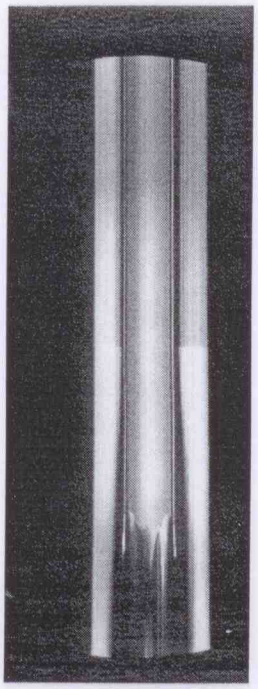
54	5.300	11.700	0.1343	278	27.700	-10.700	0.1336
55	5.400	11.600	0.1343	279	27.800	-10.800	0.1336
56	5.500	11.500	0.1342	280	27.900	-10.900	0.1335
57	5.600	11.400	0.1343	281	28.000	-11.000	0.1336
58	5.700	11.300	0.1343	282	28.100	-11.100	0.1336
59	5.800	11.200	0.1342	283	28.200	-11.200	0.1336
60	5.900	11.100	0.1342	284	28.300	-11.300	0.1336
61	6.000	11.000	0.1342	285	28.400	-11.400	0.1336
62	6.100	10.900	0.1342	286	28.500	-11.500	0.1336
63	6.200	10.800	0.1342	287	28.600	-11.600	0.1336
64	6.300	10.700	0.1342	288	28.700	-11.700	0.1336
65	6.400	10.600	0.1342	289	28.800	-11.800	0.1336
66	6.500	10.500	0.1342	290	28.900	-11.900	0.1336
67	6.600	10.400	0.1342	291	29.000	-12.000	0.1336
68	6.700	10.300	0.1342	292	29.100	-12.100	0.1335
69	6.800	10.200	0.1342	293	29.200	-12.200	0.1336
70	6.900	10.100	0.1341	294	29.300	-12.300	0.1336
71	7.000	10.000	0.1342	295	29.400	-12.400	0.1336
72	7.100	9.900	0.1342	296	29.500	-12.500	0.1336
73	7.200	9.800	0.1341	297	29.600	-12.600	0.1336
74	7.300	9.700	0.1341	298	29.700	-12.700	0.1336
75	7.400	9.600	0.1341	299	29.800	-12.800	0.1336
76	7.500	9.500	0.1341	300	29.900	-12.900	0.1336
77	7.600	9.400	0.1341	301	30.000	-13.000	0.1336
78	7.700	9.300	0.1341	302	30.100	-13.100	0.1336
79	7.800	9.200	0.1341	303	30.200	-13.200	0.1336
80	7.900	9.100	0.1341	304	30.300	-13.300	0.1336
81	8.000	9.000	0.1341	305	30.400	-13.400	0.1336
82	8.100	8.900	0.1341	306	30.500	-13.500	0.1336
83	8.200	8.800	0.1341	307	30.600	-13.600	0.1336
84	8.300	8.700	0.1341	308	30.700	-13.700	0.1336
85	8.400	8.600	0.1340	309	30.800	-13.800	0.1336
86	8.500	8.500	0.1341	310	30.900	-13.900	0.1336
87	8.600	8.400	0.1340	311	31.000	-14.000	0.1336
88	8.700	8.300	0.1340	312	31.100	-14.100	0.1336
89	8.800	8.200	0.1340	313	31.200	-14.200	0.1336
90	8.900	8.100	0.1340	314	31.300	-14.300	0.1336
91	9.000	8.000	0.1340	315	31.400	-14.400	0.1336
92	9.100	7.900	0.1340	316	31.500	-14.500	0.1336
93	9.200	7.800	0.1340	317	31.600	-14.600	0.1335
94	9.300	7.700	0.1339	318	31.700	-14.700	0.1336
95	9.400	7.600	0.1339	319	31.800	-14.800	0.1335
96	9.500	7.500	0.1339	320	31.900	-14.900	0.1335
97	9.600	7.400	0.1339	321	32.000	-15.000	0.1335
98	9.700	7.300	0.1339	322	32.100	-15.100	0.1335
99	9.800	7.200	0.1339	323	32.200	-15.200	0.1335
100	9.900	7.100	0.1339	324	32.300	-15.300	0.1335
101	10.000	7.000	0.1339	325	32.400	-15.400	0.1335
102	10.100	6.900	0.1338	326	32.500	-15.500	0.1335
103	10.200	6.800	0.1339	327	32.600	-15.600	0.1335
104	10.300	6.700	0.1338	328	32.700	-15.700	0.1335
105	10.400	6.600	0.1338	329	32.800	-15.800	0.1335
106	10.500	6.500	0.1338	330	32.900	-15.900	0.1335
107	10.600	6.400	0.1337	331	33.000	-16.000	0.1335
108	10.700	6.300	0.1337	332	33.100	-16.100	0.1335
109	10.800	6.200	0.1337	333	33.200	-16.200	0.1335
110	10.900	6.100	0.1337	334	33.300	-16.300	0.1335
111	11.000	6.000	0.1336	335	33.400	-16.400	0.1334
112	11.100	5.900	0.1336	336	33.500	-16.500	0.1334
113	11.200	5.800	0.1334	337	33.600	-16.600	0.1334
114	11.300	5.700	0.1322	338	33.700	-16.700	0.1334
115	11.400	5.600	0.1307	339	33.800	-16.800	0.1334
116	11.500	5.500	0.1319	340	33.900	-16.900	0.1334
117	11.600	5.400	0.1325	341	34.000	-17.000	0.1334

ɔw the center with 0.100 MM increment

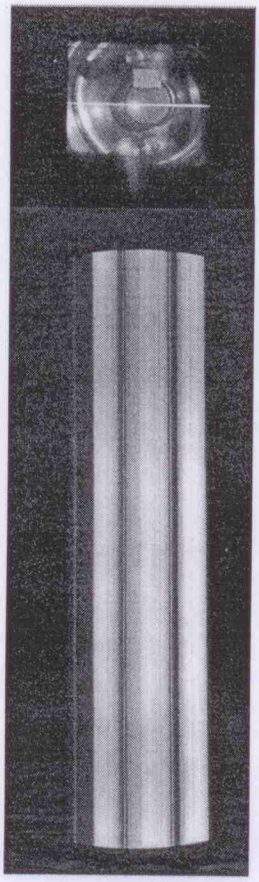
Number of Reading	Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
118	11.700	5.300			
119	11.800	5.200			
120	11.900	5.100			
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	0.00320		
125	12.400	4.600	0.00275		
126	12.500	4.500	0.00250	0.00255	
127	12.600	4.400	0.00240	0.00230	
128	12.700	4.300	0.00230	0.00230	
129	12.800	4.200	0.00220	0.00220	..
130	12.900	4.100	0.00215	0.00215	0.00215
131	13.000	4.000	0.00210	0.00205	0.00205
132	13.100	3.900	0.00200	0.00195	0.00195
133	13.200	3.800	0.00195	0.00185	0.00185
134	13.300	3.700	0.00185	0.00180	0.00180
135	13.400	3.600	0.00175	0.00175	0.00175
136	13.500	3.500	0.00165	0.00165	0.00165
137	13.600	3.400	0.00150	0.00155	0.00155
138	13.700	3.300	0.00150	0.00150	0.00150
139	13.800	3.200	0.00140	0.00145	0.00145
140	13.900	3.100	0.00135	0.00140	0.00140
141	14.000	3.000	0.00130	0.00130	0.00130
142	14.100	2.900	0.00120	0.00120	0.00120
143	14.200	2.800	0.00115	0.00115	0.00115
144	14.300	2.700	0.00105	0.00110	0.00110
145	14.400	2.600	0.00100	0.00100	0.00100
146	14.500	2.500	0.00095	0.00095	0.00095
147	14.600	2.400	0.00085	0.00090	0.00090
148	14.700	2.300	0.00085	0.00085	0.00085
149	14.800	2.200	0.00075	0.00075	0.00075
150	14.900	2.100	0.00070	0.00070	0.00070
151	15.000	2.000	0.00065	0.00065	0.00065
152	15.100	1.900	0.00060	0.00060	0.00060
153	15.200	1.800	0.00050	0.00055	0.00055
154	15.300	1.700	0.00045	0.00050	0.00050
155	15.400	1.600	0.00040	0.00045	0.00045
156	15.500	1.500	0.00040	0.00040	0.00040
157	15.600	1.400	0.00030	0.00035	0.00035
158	15.700	1.300	0.00030	0.00030	0.00030
159	15.800	1.200	0.00025	0.00025	0.00025
160	15.900	1.100	0.00020	0.00025	0.00025
161	16.000	1.000	0.00020	0.00020	0.00020
162	16.100	0.900	0.00015	0.00015	0.00015
163	16.200	0.800	0.00010	0.00010	0.00010
164	16.300	0.700	0.00010	0.00010	0.00010
165	16.400	0.600	0.00010	0.00010	0.00010
166	16.500	0.500	0.00005	0.00010	0.00010
167	16.600	0.400	0.00005	0.00010	0.00010
168	16.700	0.300	0.00005	0.00005	0.00005
169	16.800	0.200	0.00005	0.00005	0.00005
170	16.900	0.100	0.00005	0.00005	0.00005

171	17.000	0.000	0.00000	0.00000	0.00000
172	17.100	-0.100	0.00005	0.00005	0.00005
173	17.200	-0.200	0.00005	0.00005	0.00005
174	17.300	-0.300	0.00005	0.00005	0.00005
175	17.400	-0.400	0.00010	0.00010	0.00010
176	17.500	-0.500	0.00010	0.00010	0.00010
177	17.600	-0.600	0.00010	0.00015	0.00015
178	17.700	-0.700	0.00015	0.00015	0.00015
179	17.800	-0.800	0.00015	0.00020	0.00020
180	17.900	-0.900	0.00020	0.00020	0.00020
181	18.000	-1.000	0.00025	0.00020	0.00020
182	18.100	-1.100	0.00030	0.00025	0.00025
183	18.200	-1.200	0.00030	0.00030	0.00030
184	18.300	-1.300	0.00035	0.00035	0.00035
185	18.400	-1.400	0.00040	0.00035	0.00035
186	18.500	-1.500	0.00040	0.00040	0.00040
187	18.600	-1.600	0.00045	0.00045	0.00045
188	18.700	-1.700	0.00050	0.00055	0.00055
189	18.800	-1.800	0.00055	0.00060	0.00060
190	18.900	-1.900	0.00065	0.00065	0.00065
191	19.000	-2.000	0.00070	0.00065	0.00065
192	19.100	-2.100	0.00075	0.00080	0.00080
193	19.200	-2.200	0.00080	0.00080	0.00080
194	19.300	-2.300	0.00085	0.00085	0.00085
195	19.400	-2.400	0.00095	0.00095	0.00095
196	19.500	-2.500	0.00095	0.00100	0.00100
197	19.600	-2.600	0.00100	0.00105	0.00105
198	19.700	-2.700	0.00110	0.00110	0.00110
199	19.800	-2.800	0.00120	0.00120	0.00120
200	19.900	-2.900	0.00125	0.00130	0.00130
201	20.000	-3.000	0.00130	0.00130	0.00130
202	20.100	-3.100	0.00135	0.00140	0.00140
203	20.200	-3.200	0.00145	0.00150	0.00150
204	20.300	-3.300	0.00150	0.00155	0.00155
205	20.400	-3.400	0.00155	0.00160	0.00160
206	20.500	-3.500	0.00160	0.00170	0.00170
207	20.600	-3.600	0.00170	0.00175	0.00175
208	20.700	-3.700	0.00180	0.00180	0.00180
209	20.800	-3.800	0.00190	0.00195	0.00195
210	20.900	-3.900	0.00200	0.00200	0.00200
211	21.000	-4.000	0.00205	0.00215	0.00215
212	21.100	-4.100	0.00220	0.00220	0.00220
213	21.200	-4.200	0.00250	0.00270	0.00270
214	21.300	-4.300	0.00315	0.00350	0.00350
215	21.400	-4.400	0.00305	0.00305	
216	21.500	-4.500	0.00270	0.00280	
217	21.600	-4.600	0.00260	0.00270	
218	21.700	-4.700	0.00260		
219	21.800	-4.800	0.00265		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

SHOT 1070



f8



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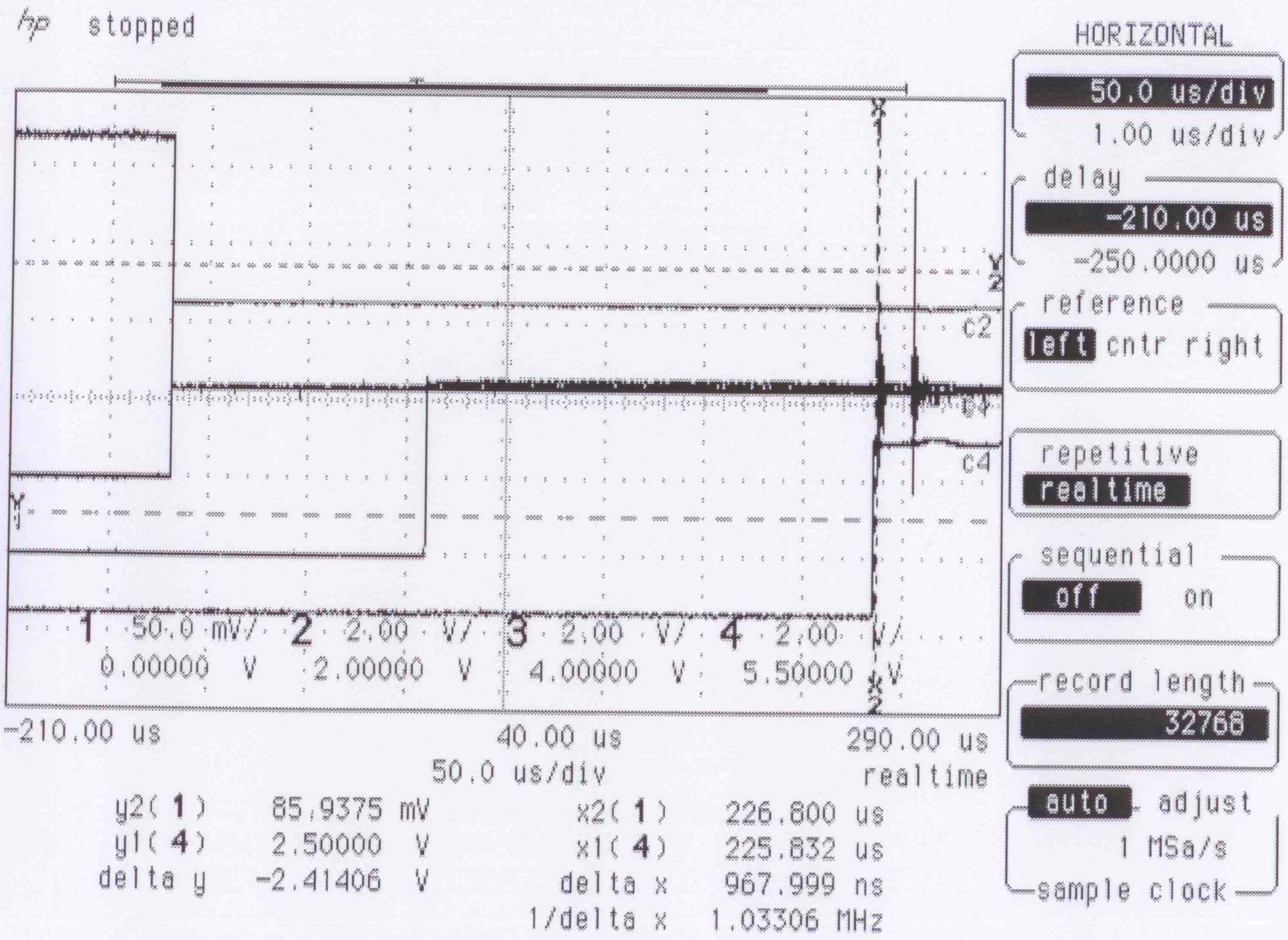
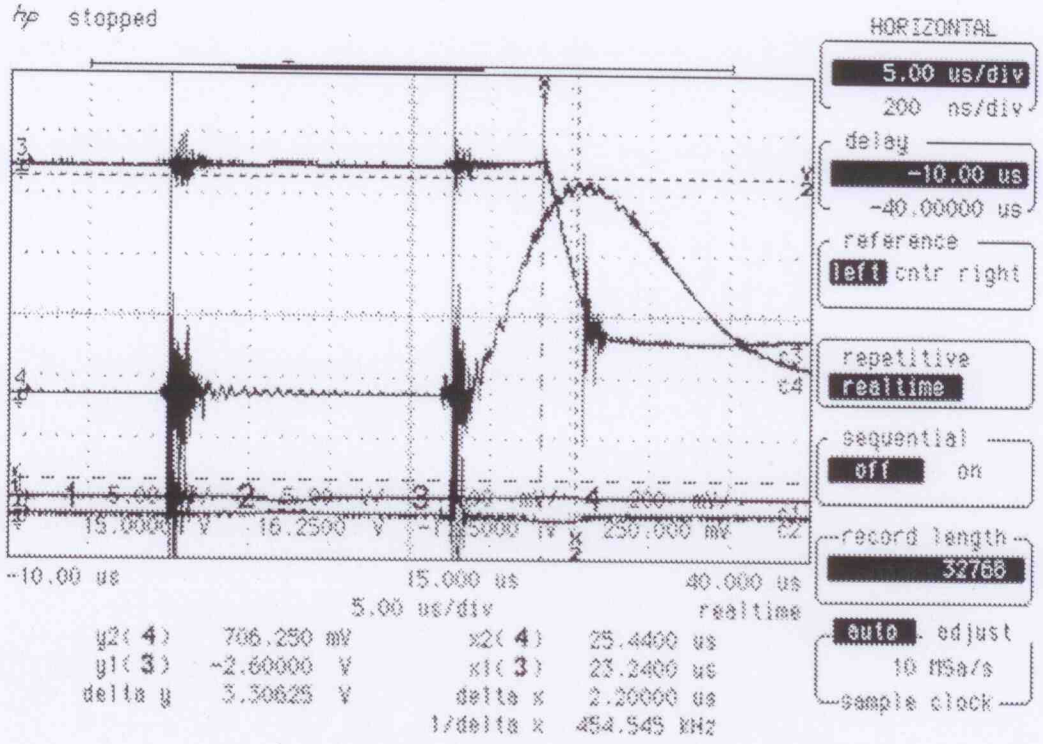
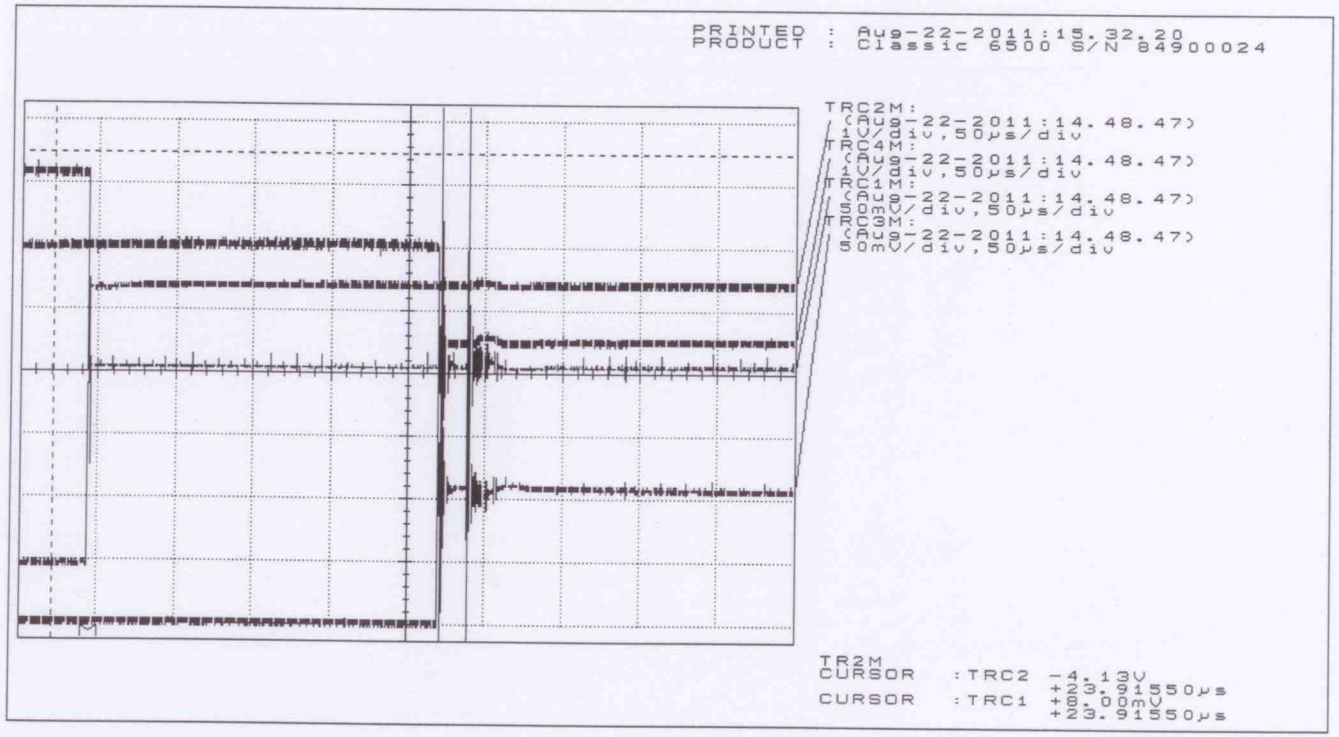
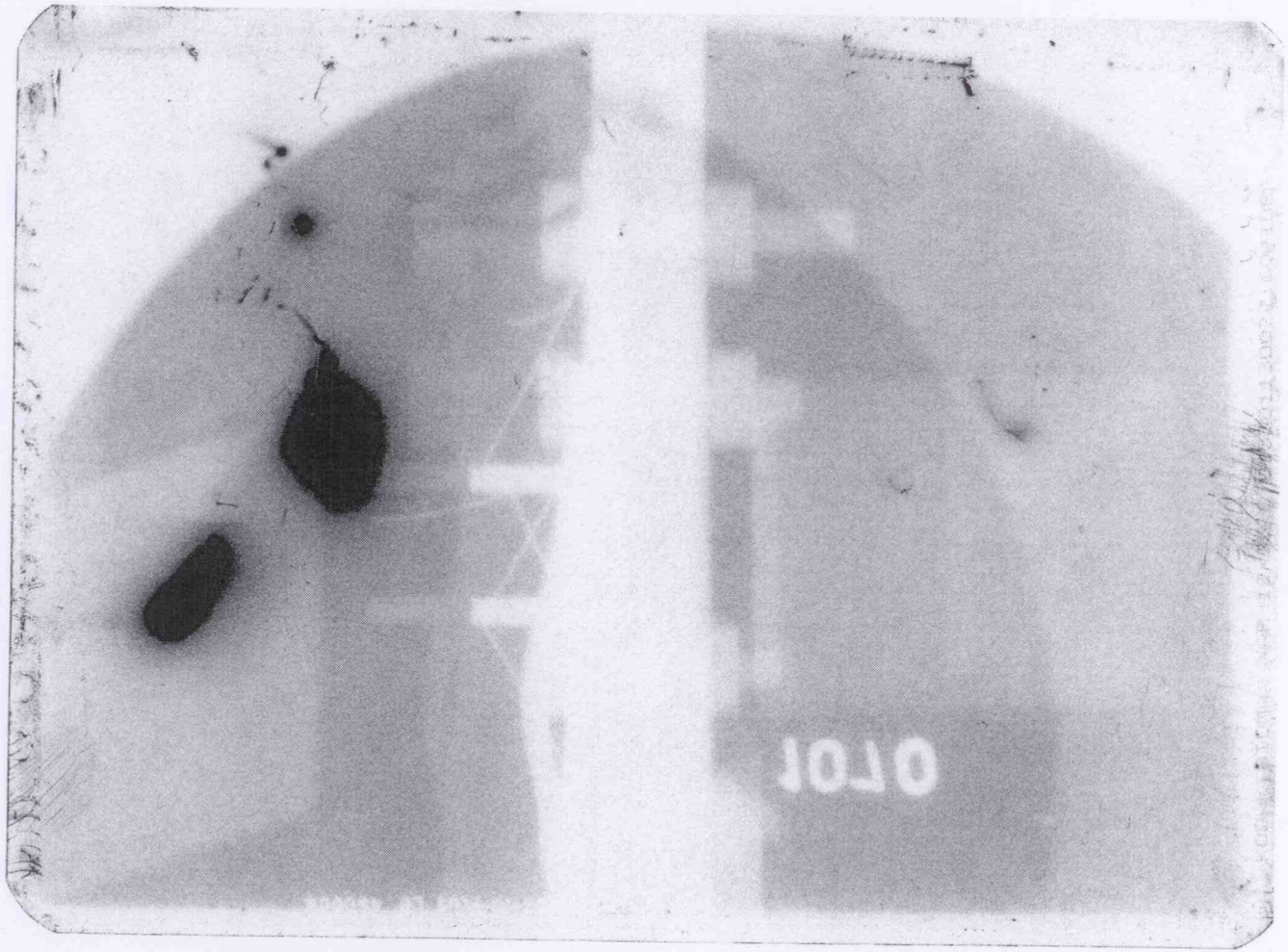

stopped
HORIZONTAL
50.0 us/div
1.00 us/div
delay
-210.00 us
-250.0000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
1 MSa/s
sample clock
1 50.0 mV/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/
0.00000 V 2.00000 V 4.00000 V 5.50000 V
-210.00 us
40.00 us
290.00 us
50.0 us/div
realtime
y2(1) 85.9375 mV
y1(4) 2.50000 V
delta y -2.41406 V
x2(1) 226.800 us
x1(4) 225.832 us
delta x 967.999 ns
1/delta x 1.03306 MHz


hp stopped
HORIZONTAL
5.00 us/div
200 ns/div
delay
-10.00 us
-40.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
10 MSa/s
sample clock
-10.00 us
15.000 us
40.000 us
5.00 us/div
realtime
y2(4) 706.250 mV
y1(3) -2.60000 V
delta y 3.30625 V
x2(4) 25.4400 us
x1(3) 23.2400 us
delta x 2.20000 us
1/delta x 454.545 kHz


PRINTED : Aug-22-2011:15.32.20
PRODUCT : Classic 6500 S/N 84900024
TRC2M:
(Aug-22-2011:14.48.47)
1V/div,50µs/div
TRC4M:
(Aug-22-2011:14.48.47)
1V/div,50µs/div
TRC1M:
(Aug-22-2011:14.48.47)
50mV/div,50µs/div
TRC3M:
(Aug-22-2011:14.48.47)
50mV/div,50µs/div
TR2M
CURSOR :TRC2 -4.13V
+23.91550µs
CURSOR :TRC1 +8.00mV
+23.91550µs



40 mm GUN DATA SHEET

Shot No. 1071 Date _____

Target:

Sample Material: Anorthite - Diopside - Hedenbergite Mix

Type of Measurement: Pre-heated EOS 1400°C

Expected Velocity: 1.500 km/sec.

Projectile:

Flyer Material: Mo (#5) Thickness: 0.09935 in. Weight: 20.090 gms.

Projectile Material: LEXAN Length: 2.500 in. Dia: 1.560/1.567 in.

Weight: ± 97.4452 gms. Corrected Weight: 93.4452 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle

Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400

Main Charge Weight: 130.82 gms. Powder Type: IMR4350 C/M: 1.40

Laser Distances:

Beam I to Muzzle: 68.4 / 68.4 cm. Co-axial Pin Height: - in.

Beam II to Muzzle: 43.10 / 43.1 cm. Shim Thickness: - in.

Beam III to Muzzle: 2.1 / 2.1 cm. Total Height: - cm.

Beam III to Target: 51.717 / 51.727 mm. Corrected III to Target Distance: - cm.

Estimated Times:

Beam I to II: 168.66 µsec.

Beam II to III: 301.3 µsec.

Beam III to Target: 34.48 µsec.

Actual Beam Distances:

Beam I to II: 0.2530 m.

Beam II to III: 0.4520 m.

Beam III to Target: 0.051722 m.

Delays:

Xenon Lamp Delay: -6.127 µsec. Lamp Triggered by Laser No.: 3

X-ray 1 to 2 Interval: 24.295 µsec. Camera dial 270 for 2000 ns streak

Notes:

Heater shut down @ 1250°C — cooling water NOT on

Xrays - pretrigged on the SIM 2x — Pretrigged on the shot 1x
= Total Xrays 4x's

Back up counter - Did NOT GATE

HP6 - Did NOT Trigger - Potential Xray problem.

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: — µsec.
UDC 307.31 µsec
Counter 6 X-ray interval 24.346 µsec
Tank/Pump Pressure: 110 / 100 µm.

HP6-1 —	ns*	HP5-1 -173.368	µsec	GS7-1 ~5.80µs	µsec
HP6-2 —	µsec	HP5-2 -173.088	µsec	GS7-2 -5.60µs	ns*
HP6-3 —	µsec	HP5-3 0	ns*	GS7-3 301.485	µsec
HP6-4 —	µsec	HP5-4 307.358	µsec	GS7-4 301.660	µsec

Measured Shot Velocities:

Velocity, X-ray:_____ km/sec.

Backup Velocity, X-ray : — km/s
UDC : 1470.84 km/sec

SETUP: SHOT for scopes

HP6

trig : Ch1 50V+ - second hump (above 30V for 30ns) –lvl 10V+ 5V
Ch2 50V+ - second hump (above 30V for 30ns) 5 V
Ch3 cam monitor -- -1.75V -- set 500mV
Ch4 photodiode—peak brightness—set 200mV

TOTAL TIME (from wksht): 330 us
Set time 655 us (1µs /div)
Delay from trig -40 us (need: 0)

HP5

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V 2V
Ch1 laser1 analog -- downgoing 150mV 50mV
Ch2 laser 1 TTL, 4V -- level 2.5V+ 2V
Ch4 laser 3 4V TTL -- jog in sig ~2.5V 2V

TOTAL TIME (from wksht): 470 us
Set time 655 us (1µs /div)
Delay from trig -250 us (need: -170)

GS7

trig : Ch2 laser 2 TTL -- 4V+ 50mV
Ch1 laser 2 analog -- -150mV 1V
Ch3 laser 3 analog -- -150mV 50mV
Ch4 laser 3 TTL –4V+ 1V

TOTAL TIME (from wksht): 301 us
Set time 500 us (M: 50 us)
Pretrigger view 9 %

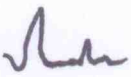
40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: 24.999 µsec.

UDC 226.7 µsec

Counter 6 X-ray interval 24.829 µsec

HP6-1 37ns ns* strange shape 

HP6-2 25.036 µsec

HP6-3 24.100 µsec

HP6-4 25.380 µsec

HP5-1 -2.104 µsec

HP5-2 224.600 µsec

HP5-3 8.00 ns*

HP5-4 226.700 µsec

Measured Shot Velocities:

UDC : 1993.81 m/sec

Cal frequency 147.9850 MHz

SETUP: SIM for scopes

HP6

trig : Ch1 xray 1 50V+ 5V

- second hump (above 30V for 30ns) –lvl 10V+

Ch2 xray2 50V+ - second hump (above 30V for 30ns) 5V

Ch3 cam monitor -- -1.75V -- set 500mV

Ch4 photodiode—peak brightness—set 200mV

TOTAL TIME (from wksht): 330 us

Set time 655 us (1µs /div)

Delay from trig -40 us (need: 0)

HP5

trig Ch3 laser 2 5V TTL -- jog in sig ~2.5V 2V

Ch1 Mag sim 1 -- zero crossing (6V) 2V

Ch2 Mag sim 2 2V

Ch4 laser 3 5V TTL -- jog in sig ~2.5V 2V

TOTAL TIME (from wksht): 303 us

Set time 655 us (7µs /div)

Delay from trig -40 us (need: -2ns)

40 mm hot EOS shot Nominal Timeline Preshot

V	1500			Laser1-Laser2 distance	0.253
cable time	75			Laser2-Laser3 distance	0.452
photodiode intrinsic delays	[redacted]			Laser3-target distance	0.051722
UDC extra count lag	118	2140	2140	Laser3-target fudge	0.050244
pulse translator delay	150			Laser3-Xray2 % of Laser3-target	75
X-ray 1 program delay	0	971	X-ray 1 delay amp intrinsic		
X-ray 2 program delay	24295	1216	X-ray 2 delay amp intrinsic		
X-ray 1 pulser delay	426			Us(Mo)	5904.01699
X-ray 2 pulser delay	887			driver thickness	0.00112014
Lamp trigger to peak bright	[redacted]			sample thickness	0.00254
HV3 program delay	-6127			cap thickness	0.00077902
Camera intrinsic delay	107			estimated sample+cover time	593.446816
Streak duration	2000				
d dead streak before driver	600				

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-168667	-0.253		Laser 1 actual interrupt		HP5-1
-168467	-0.2527		Laser 1 TTL out		
-168392	-0.2525875		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
200	0.0003		Laser 2 TTL out (shot)		GS7-2 & Trig
-1865	-0.0027975		Magnet Sim 1 analog (sim)	HP5-1	
275	0.0004125		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
301333	0.452		Laser 3 actual interrupt		GS7-3
301533	0.4523		Laser 3 TTL out		GS7-4
299468	0.4492025		Magnet Sim 2 analog (sim)	HP5-2	
301608	0.4524125		Laser 3 TTL at UDC (start down-count) and pulse translat	HP5-4, UDC stop	HP5-4, UDC stop
301833	0.45275		Pulse translator out reaches X-ray delay amps 1 & 2		
302804	0.4542065		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
303230	0.4548455		X-ray 1 fires		
303305	0.454958		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
327344	0.4910165		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
328231	0.4907915		X-ray 2 fires		
328306	0.4924595		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
329095	0.49364309		HV3 out to lamp		
335222	0.50283359		UDC zero time, HV1 out to camera		
335297	0.50294609		Trigger at camera		
335404	0.50310659		Begin Streak		
335479	0.50321909		Camera Monitor reaches control lab	HP6-3	HP6-3
336372	0.50455859		Lamp Peak Bright	HP6-4	HP6-4
335815	0.503722	0	IMPACT		
336004		0.00112014	Driver arrival on streak	Driver cutoff on streak	600
336598		0.00462386	Sample cutoff on streak	Sample cutoff on sreak	1193
337404		0.009385764	End Streak		

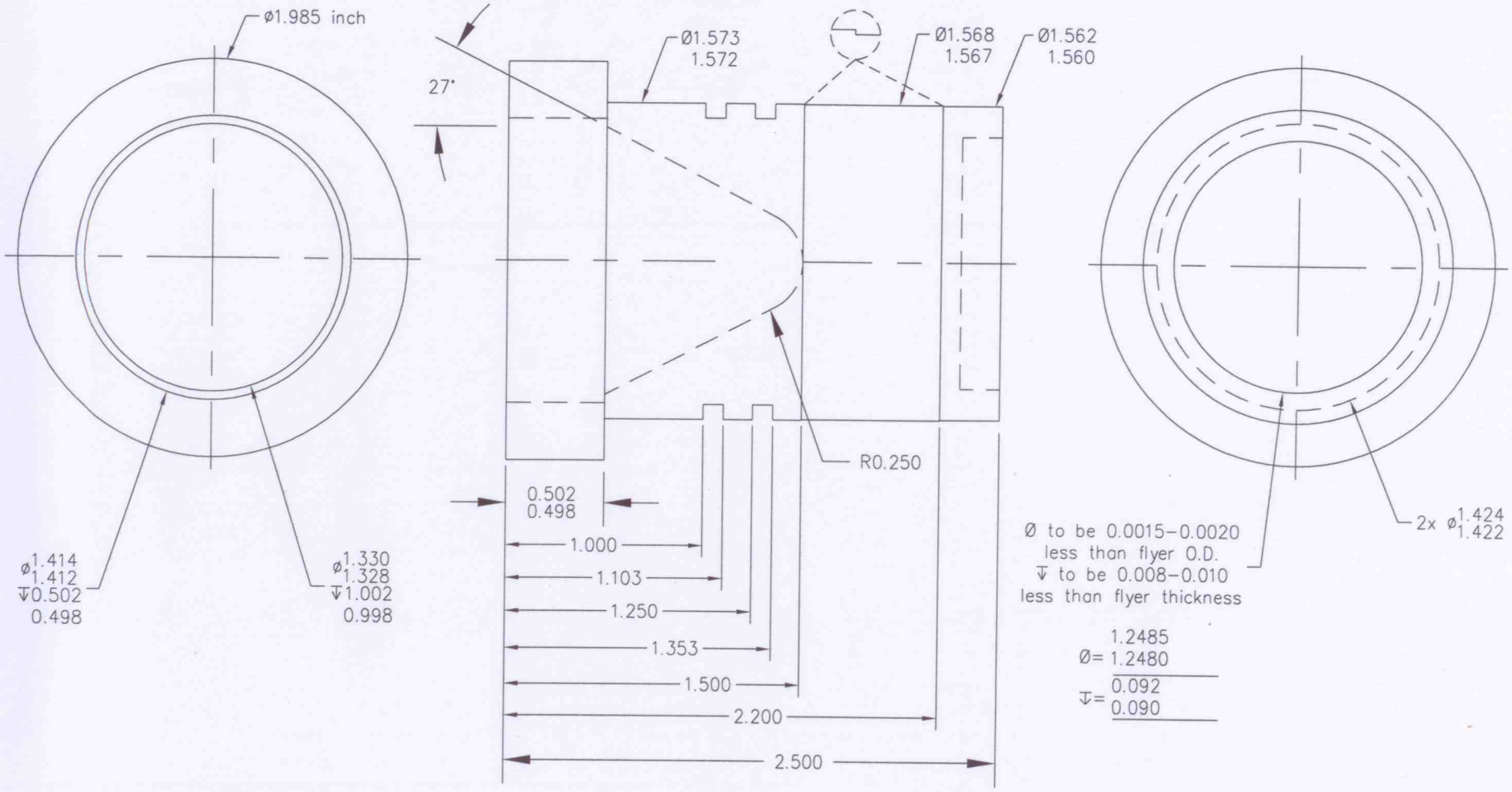
	rho0	Co	s		
Cold Mo	10206	5033	1.28946405		
Hot Mo	9937	4918.5831	1.28837124	1407	
Liquid An-Di-Hd	[redacted]		1.5714		

				up	P	Us
driver	357.7250824	-139723569	1.06661E+11	764.867969	44.8734399	5904.01699
sample	8500.08324	-95836730	1.04726E+11	1226.09183	16.0212888	4772.4807
cap	-8500.08324	-77768557	44978369324	545.801567	30.4904455	5621.77814

Cold Mo	10206	5033	1.28946405	
Hot Mo	9961.5	4927.8728	1.288702471	1300
	9937	4918.5831	1.28837124	1407
	9913	4908.7717	1.2882417	1508
	9875	4893.13	1.28807834	1659

	SIM	SHOT		
HP5 1	-2140	-168942		
HP5 2	299193	-168667		
HP5 3	0	0	303473	470275
HP5 4	301333	301333		
UDC upcount:	301333	301333		
HP6 1	0	0		
HP6 2	25001	25001		
HP6 3	32174	32174		
HP6 4	33067	33067		
GS7 1		-275		
GS7 2		0		
GS7 3		301133		
GS7 4		301333		
Counter 4b:	25001	25001		
Counter 6:	24540	24540		

1071



Note: Use only Westlake Plastics
Zelux M Polycarbonate

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED TOLERANCES:
.000 ±.005
.00 ±.01
FRACTIONS ±1/64
ANGLES ±1/2
CONCENTRICITY .005 T.I.R.
BREAK SHARP EDGES AND REMOVE BURRS

DRAWN	M. Long	DATE	3/20/09
ENGINEER		DATE	
APPROVED		DATE	
FINISH	16		
MATERIAL	Polycarbonate		

CALIFORNIA INSTITUTE of TECHNOLOGY
SHOCK WAVE LABORATORY

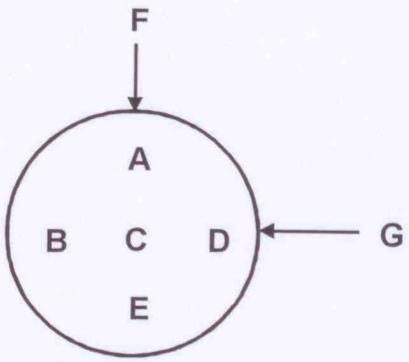
TITLE: 40 mm Propellant Projectile Sabot

SCALE	SHEET		DRAWING NUMBER
2:1	1 of 2	B	40mm-048C

SHOT No.

FLYER PLATE MATERIAL: **Mo #5** 6/28/2011

Measurement done by: Russ



DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.09905	F	1.25050
A	0.09930	F	1.25050
B	0.09955	G	1.25050
B	0.09955	G	1.25050
C	0.09950		
C	0.09940		
D	0.09915		
D	0.09905		
E	0.09940		
E	0.09945		

Statistic for thickness

N	10
MAX	0.09955
MIN	0.09905
Range	0.00050
MEAN	0.099357143
	2.523671429
STDEV	0.000198806

Statistic for Diameter (F-G)

N	4	
MAX	1.25050	
MIN	1.25050	
Range	0.00000	
MEAN	1.2505000	inch
	31.7627000	mm
STDEV	0	

	Sample in Air	Crystal Density	
1	20.0898	10.086	
2	20.09010	10.088	
3	20.08960	10.084	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.099357143	±	in
FLATNESS:	0.00050	in.	
VOLUME:	1.9997	5.05E-04	cm^3
CRYSTAL DENSITY:	10.0860	2.00E-03	$grams/cm^3$
BULK DENSITY:	10.0466	5.64E-04	$grams/cm^3$
DENSITIES CHECKED BY: _____		on _____	
MEASUREMENT CHECKED E	Russ	6/28/2011	

SHOT No. ____1071_____ tip used: .7mm long/ flat tip

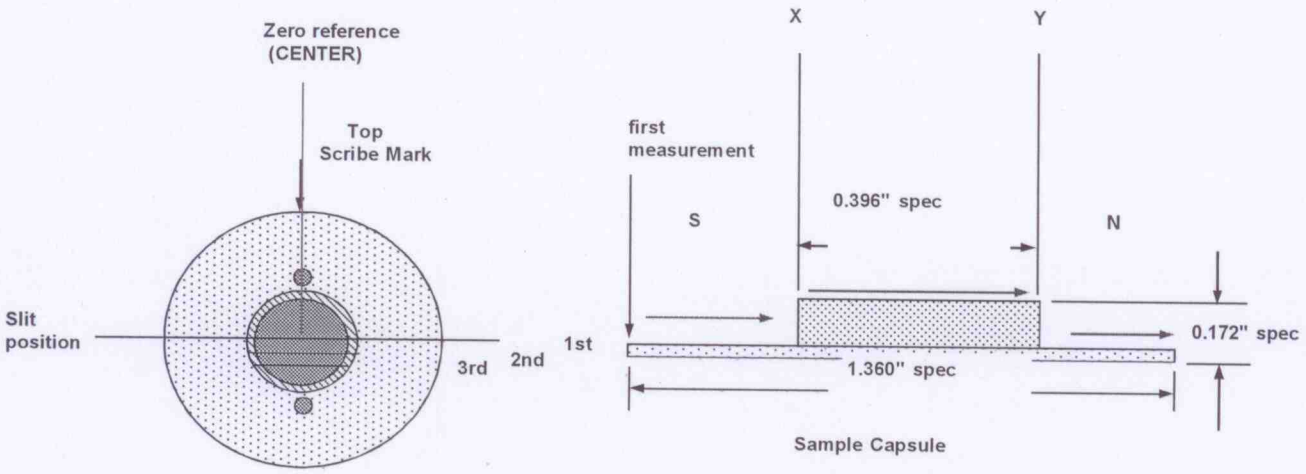
SAMPLE CAPSULE: 24 note: the platform on which the measurement was taken

SAMPLE MATERIAL: An-Di-Hd deviates from flat by +0.013 max.

direction of measurement

2.3575

THICKNESS PROFILE (Not re-polished, but final surface) 1.99



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = 0.00031

Second Run Horizontal (-y) 0.500 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00028

Third Run Horizontal (-y) 01.00 MM Below the center with 0.100 MM increment

3rd Reading

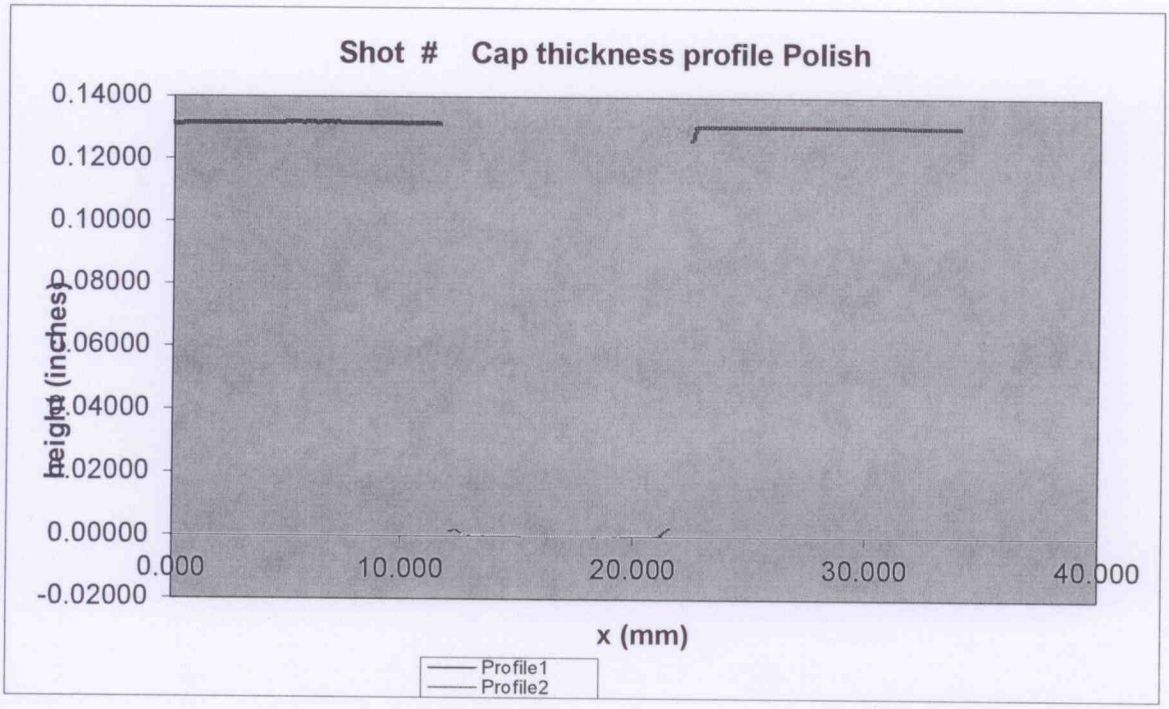
Average thickness reading = 0.00023

Note: Measurement from reference zero point from the base is = **-0.1754** Inches
-4.4539 mm

Average thickness of the driver Plate = -0.0441 Inches
-1.1193 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
-0.02000
Height (inches)
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1
Profile2

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) .5 MM Below

3. Third Run Horizontal (-y) 1 MM Below the center with 0.100 MM increment

Number	Reading	abs dist.		Number	Reading	abs dist.	
3	Distance			of	Distance		
Reading	mm	mm	South (left side)	Reading	mm	mm	North(right
1	0.000	17.000	0.1315	225	22.400	-5.400	0.1264
2	0.100	16.900	0.1315	226	22.500	-5.500	0.1269
3	0.200	16.800	0.1315	227	22.600	-5.600	0.1302
4	0.300	16.700	0.1315	228	22.700	-5.700	0.1310
5	0.400	16.600	0.1315	229	22.800	-5.800	0.1310
6	0.500	16.500	0.1316	230	22.900	-5.900	0.1311
7	0.600	16.400	0.1315	231	23.000	-6.000	0.1311
8	0.700	16.300	0.1316	232	23.100	-6.100	0.1311
9	0.800	16.200	0.1316	233	23.200	-6.200	0.1311
10	0.900	16.100	0.1316	234	23.300	-6.300	0.1310
11	1.000	16.000	0.1316	235	23.400	-6.400	0.1310
12	1.100	15.900	0.1316	236	23.500	-6.500	0.1310
13	1.200	15.800	0.1316	237	23.600	-6.600	0.1310
14	1.300	15.700	0.1317	238	23.700	-6.700	0.1310
15	1.400	15.600	0.1317	239	23.800	-6.800	0.1310
16	1.500	15.500	0.1317	240	23.900	-6.900	0.1310
17	1.600	15.400	0.1317	241	24.000	-7.000	0.1310
18	1.700	15.300	0.1317	242	24.100	-7.100	0.1311
19	1.800	15.200	0.1317	243	24.200	-7.200	0.1310
20	1.900	15.100	0.1318	244	24.300	-7.300	0.1310
21	2.000	15.000	0.1317	245	24.400	-7.400	0.1311
22	2.100	14.900	0.1318	246	24.500	-7.500	0.1310
23	2.200	14.800	0.1318	247	24.600	-7.600	0.1310
24	2.300	14.700	0.1318	248	24.700	-7.700	0.1310
25	2.400	14.600	0.1318	249	24.800	-7.800	0.1311
26	2.500	14.500	0.1318	250	24.900	-7.900	0.1311
27	2.600	14.400	0.1318	251	25.000	-8.000	0.1311
28	2.700	14.300	0.1318	252	25.100	-8.100	0.1311
29	2.800	14.200	0.1318	253	25.200	-8.200	0.1311
30	2.900	14.100	0.1318	254	25.300	-8.300	0.1311
31	3.000	14.000	0.1318	255	25.400	-8.400	0.1311
32	3.100	13.900	0.1319	256	25.500	-8.500	0.1311
33	3.200	13.800	0.1319	257	25.600	-8.600	0.1311
34	3.300	13.700	0.1319	258	25.700	-8.700	0.1311
35	3.400	13.600	0.1319	259	25.800	-8.800	0.1311
36	3.500	13.500	0.1319	260	25.900	-8.900	0.1310
37	3.600	13.400	0.1319	261	26.000	-9.000	0.1310
38	3.700	13.300	0.1319	262	26.100	-9.100	0.1310
39	3.800	13.200	0.1319	263	26.200	-9.200	0.1310
40	3.900	13.100	0.1319	264	26.300	-9.300	0.1311
41	4.000	13.000	0.1319	265	26.400	-9.400	0.1310
42	4.100	12.900	0.1319	266	26.500	-9.500	0.1310
43	4.200	12.800	0.1319	267	26.600	-9.600	0.1310
44	4.300	12.700	0.1319	268	26.700	-9.700	0.1310
45	4.400	12.600	0.1319	269	26.800	-9.800	0.1310
46	4.500	12.500	0.1319	270	26.900	-9.900	0.1310
47	4.600	12.400	0.1319	271	27.000	-10.000	0.1310
48	4.700	12.300	0.1319	272	27.100	-10.100	0.1310
49	4.800	12.200	0.1319	273	27.200	-10.200	0.1310
50	4.900	12.100	0.1319	274	27.300	-10.300	0.1310
51	5.000	12.000	0.1320	275	27.400	-10.400	0.1310
52	5.100	11.900	0.1319	276	27.500	-10.500	0.1310
53	5.200	11.800	0.1319	277	27.600	-10.600	0.1310

54	5.300	11.700	0.1320	278	27.700	-10.700	0.1310
55	5.400	11.600	0.1320	279	27.800	-10.800	0.1310
56	5.500	11.500	0.1320	280	27.900	-10.900	0.1310
57	5.600	11.400	0.1319	281	28.000	-11.000	0.1310
58	5.700	11.300	0.1319	282	28.100	-11.100	0.1310
59	5.800	11.200	0.1319	283	28.200	-11.200	0.1310
60	5.900	11.100	0.1320	284	28.300	-11.300	0.1310
61	6.000	11.000	0.1319	285	28.400	-11.400	0.1310
62	6.100	10.900	0.1320	286	28.500	-11.500	0.1310
63	6.200	10.800	0.1319	287	28.600	-11.600	0.1310
64	6.300	10.700	0.1319	288	28.700	-11.700	0.1310
65	6.400	10.600	0.1319	289	28.800	-11.800	0.1310
66	6.500	10.500	0.1319	290	28.900	-11.900	0.1310
67	6.600	10.400	0.1320	291	29.000	-12.000	0.1310
68	6.700	10.300	0.1319	292	29.100	-12.100	0.1310
69	6.800	10.200	0.1319	293	29.200	-12.200	0.1309
70	6.900	10.100	0.1320	294	29.300	-12.300	0.1310
71	7.000	10.000	0.1319	295	29.400	-12.400	0.1309
72	7.100	9.900	0.1319	296	29.500	-12.500	0.1310
73	7.200	9.800	0.1320	297	29.600	-12.600	0.1310
74	7.300	9.700	0.1319	298	29.700	-12.700	0.1309
75	7.400	9.600	0.1319	299	29.800	-12.800	0.1309
76	7.500	9.500	0.1319	300	29.900	-12.900	0.1309
77	7.600	9.400	0.1319	301	30.000	-13.000	0.1309
78	7.700	9.300	0.1319	302	30.100	-13.100	0.1309
79	7.800	9.200	0.1319	303	30.200	-13.200	0.1309
80	7.900	9.100	0.1319	304	30.300	-13.300	0.1309
81	8.000	9.000	0.1319	305	30.400	-13.400	0.1309
82	8.100	8.900	0.1318	306	30.500	-13.500	0.1309
83	8.200	8.800	0.1318	307	30.600	-13.600	0.1309
84	8.300	8.700	0.1318	308	30.700	-13.700	0.1308
85	8.400	8.600	0.1319	309	30.800	-13.800	0.1308
86	8.500	8.500	0.1318	310	30.900	-13.900	0.1309
87	8.600	8.400	0.1319	311	31.000	-14.000	0.1308
88	8.700	8.300	0.1318	312	31.100	-14.100	0.1308
89	8.800	8.200	0.1318	313	31.200	-14.200	0.1308
90	8.900	8.100	0.1318	314	31.300	-14.300	0.1308
91	9.000	8.000	0.1318	315	31.400	-14.400	0.1308
92	9.100	7.900	0.1318	316	31.500	-14.500	0.1308
93	9.200	7.800	0.1318	317	31.600	-14.600	0.1307
94	9.300	7.700	0.1318	318	31.700	-14.700	0.1308
95	9.400	7.600	0.1318	319	31.800	-14.800	0.1307
96	9.500	7.500	0.1318	320	31.900	-14.900	0.1307
97	9.600	7.400	0.1318	321	32.000	-15.000	0.1307
98	9.700	7.300	0.1318	322	32.100	-15.100	0.1307
99	9.800	7.200	0.1318	323	32.200	-15.200	0.1307
100	9.900	7.100	0.1318	324	32.300	-15.300	0.1307
101	10.000	7.000	0.1317	325	32.400	-15.400	0.1307
102	10.100	6.900	0.1317	326	32.500	-15.500	0.1306
103	10.200	6.800	0.1317	327	32.600	-15.600	0.1306
104	10.300	6.700	0.1317	328	32.700	-15.700	0.1306
105	10.400	6.600	0.1318	329	32.800	-15.800	0.1306
106	10.500	6.500	0.1317	330	32.900	-15.900	0.1305
107	10.600	6.400	0.1317	331	33.000	-16.000	0.1305
108	10.700	6.300	0.1317	332	33.100	-16.100	0.1305
109	10.800	6.200	0.1317	333	33.200	-16.200	0.1305
110	10.900	6.100	0.1317	334	33.300	-16.300	0.1305
111	11.000	6.000	0.1318	335	33.400	-16.400	0.1305
112	11.100	5.900	0.1317	336	33.500	-16.500	0.1304
113	11.200	5.800	0.1317	337	33.600	-16.600	0.1304
114	11.300	5.700	0.1317	338	33.700	-16.700	0.1304
115	11.400	5.600	0.1317	339	33.800	-16.800	0.1304
116	11.500	5.500	0.1316	340	33.900	-16.900	0.1304
117	11.600	5.400	0.1314	341	34.000	-17.000	0.1303

the center with 0.100 MM increment

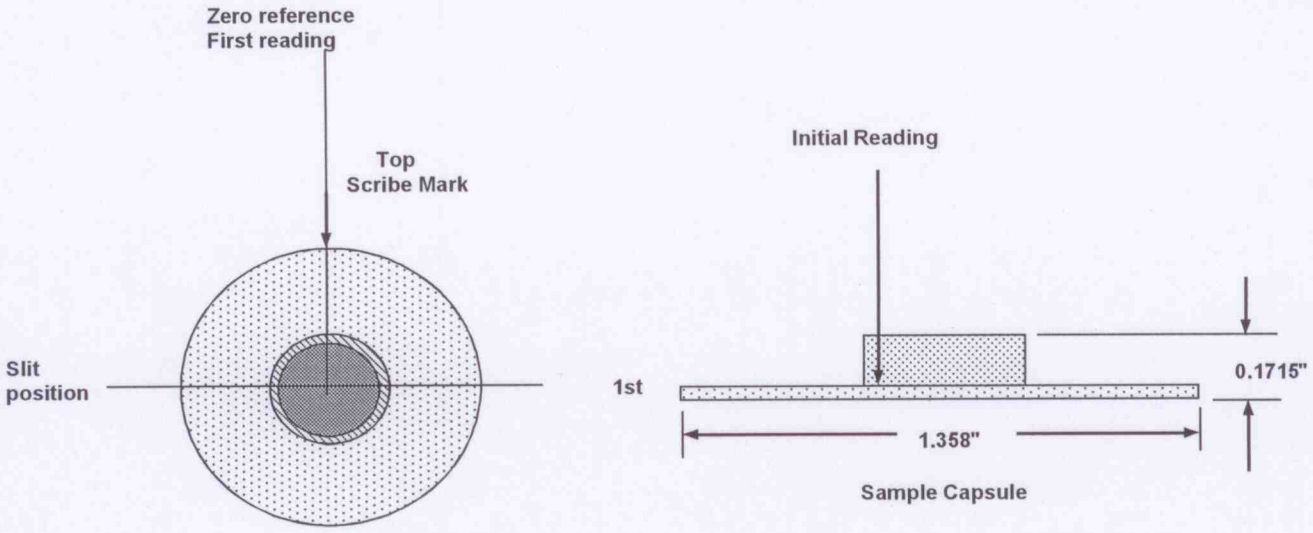
Number of Reading	Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
118	11.700	5.300			
119	11.800	5.200			
120	11.900	5.100			
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	0.00150		
125	12.400	4.600	0.00150		
126	12.500	4.500	0.00190	0.00180	
127	12.600	4.400	0.00195	0.00195	
128	12.700	4.300	0.00150	0.00170	
129	12.800	4.200	0.00100	0.00105	..
130	12.900	4.100	0.00070	0.00075	0.00080
131	13.000	4.000	0.00060	0.00060	0.00065
132	13.100	3.900	0.00050	0.00055	0.00060
133	13.200	3.800	0.00050	0.00050	0.00055
134	13.300	3.700	0.00045	0.00045	0.00050
135	13.400	3.600	0.00040	0.00045	0.00050
136	13.500	3.500	0.00040	0.00040	0.00045
137	13.600	3.400	0.00040	0.00040	0.00045
138	13.700	3.300	0.00035	0.00040	0.00045
139	13.800	3.200	0.00035	0.00035	0.00040
140	13.900	3.100	0.00030	0.00035	0.00040
141	14.000	3.000	0.00030	0.00030	0.00035
142	14.100	2.900	0.00030	0.00030	0.00035
143	14.200	2.800	0.00025	0.00030	0.00035
144	14.300	2.700	0.00025	0.00025	0.00030
145	14.400	2.600	0.00025	0.00025	0.00030
146	14.500	2.500	0.00020	0.00020	0.00025
147	14.600	2.400	0.00020	0.00020	0.00025
148	14.700	2.300	0.00015	0.00020	0.00025
149	14.800	2.200	0.00015	0.00020	0.00025
150	14.900	2.100	0.00015	0.00015	0.00020
151	15.000	2.000	0.00015	0.00020	0.00025
152	15.100	1.900	0.00015	0.00020	0.00025
153	15.200	1.800	0.00010	0.00010	0.00015
154	15.300	1.700	0.00010	0.00015	0.00020
155	15.400	1.600	0.00005	0.00010	0.00015
156	15.500	1.500	0.00005	0.00010	0.00015
157	15.600	1.400	0.00005	0.00010	0.00015
158	15.700	1.300	0.00005	0.00010	0.00015
159	15.800	1.200	0.00005	0.00010	0.00015
160	15.900	1.100	0.00005	0.00010	0.00015
161	16.000	1.000	0.00005	0.00010	0.00015
162	16.100	0.900	0.00005	0.00010	0.00015
163	16.200	0.800	0.00005	0.00005	0.00010
164	16.300	0.700	0.00005	0.00005	0.00010
165	16.400	0.600	0.00005	0.00005	0.00010
166	16.500	0.500	0.00000	0.00005	0.00010
167	16.600	0.400	0.00000	0.00010	0.00015
168	16.700	0.300	0.00000	0.00005	0.00010
169	16.800	0.200	0.00005	0.00010	0.00015
170	16.900	0.100	0.00000	0.00000	0.00005

171	17.000	0.000	0.00000	0.00000	0.00005
172	17.100	-0.100	0.00000	0.00000	0.00005
173	17.200	-0.200	0.00005	0.00000	0.00005
174	17.300	-0.300	0.00000	0.00000	0.00005
175	17.400	-0.400	0.00000	0.00005	0.00010
176	17.500	-0.500	0.00005	0.00005	0.00010
177	17.600	-0.600	0.00000	0.00000	0.00005
178	17.700	-0.700	0.00000	0.00000	0.00005
179	17.800	-0.800	0.00005	0.00005	0.00010
180	17.900	-0.900	0.00000	0.00000	0.00005
181	18.000	-1.000	0.00005	0.00000	0.00005
182	18.100	-1.100	0.00005	0.00005	0.00010
183	18.200	-1.200	0.00005	0.00005	0.00010
184	18.300	-1.300	0.00005	0.00005	0.00010
185	18.400	-1.400	-0.00005	0.00005	0.00010
186	18.500	-1.500	-0.00005	0.00010	0.00015
187	18.600	-1.600	-0.00005	0.00005	0.00010
188	18.700	-1.700	0.00000	0.00010	0.00015
189	18.800	-1.800	0.00000	0.00005	0.00010
190	18.900	-1.900	0.00000	0.00010	0.00015
191	19.000	-2.000	0.00000	0.00010	0.00015
192	19.100	-2.100	0.00005	0.00010	0.00015
193	19.200	-2.200	0.00000	0.00010	0.00015
194	19.300	-2.300	0.00005	0.00010	0.00015
195	19.400	-2.400	0.00005	0.00015	0.00020
196	19.500	-2.500	0.00005	0.00010	0.00015
197	19.600	-2.600	0.00010	0.00010	0.00015
198	19.700	-2.700	0.00010	0.00015	0.00020
199	19.800	-2.800	0.00010	0.00015	0.00020
200	19.900	-2.900	0.00010	0.00015	0.00020
201	20.000	-3.000	0.00015	0.00015	0.00020
202	20.100	-3.100	0.00015	0.00020	0.00025
203	20.200	-3.200	0.00015	0.00020	0.00025
204	20.300	-3.300	0.00020	0.00020	0.00025
205	20.400	-3.400	0.00015	0.00025	0.00030
206	20.500	-3.500	0.00025	0.00025	0.00030
207	20.600	-3.600	0.00020	0.00025	0.00030
208	20.700	-3.700	0.00020	0.00025	0.00030
209	20.800	-3.800	0.00025	0.00030	0.00035
210	20.900	-3.900	0.00020	0.00030	0.00035
211	21.000	-4.000	0.00025	0.00035	0.00040
212	21.100	-4.100	0.00025	0.00035	0.00040
213	21.200	-4.200	0.00025	0.00040	0.00045
214	21.300	-4.300	0.00035	0.00045	0.00050
215	21.400	-4.400	0.00050	0.00075	
216	21.500	-4.500	0.00105	0.00130	
217	21.600	-4.600	0.00165	0.00180	
218	21.700	-4.700	0.00240		
219	21.800	-4.800	0.00250		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

SAMPLE CAPSULE **24**
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

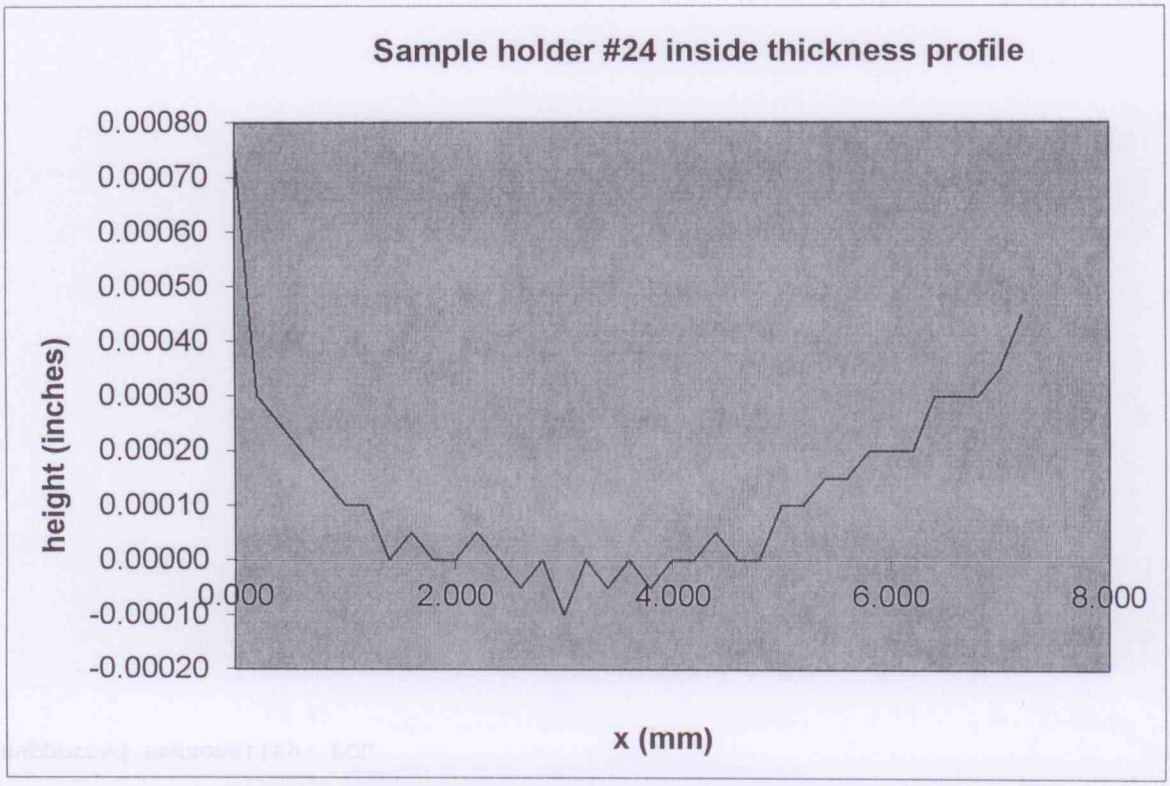
4.683
4.623



1.338582677

Average thickness reading = 0.00012

Note: The thickness of the reference zero point from the base is = **0.04250** Inches
1.0795 mm



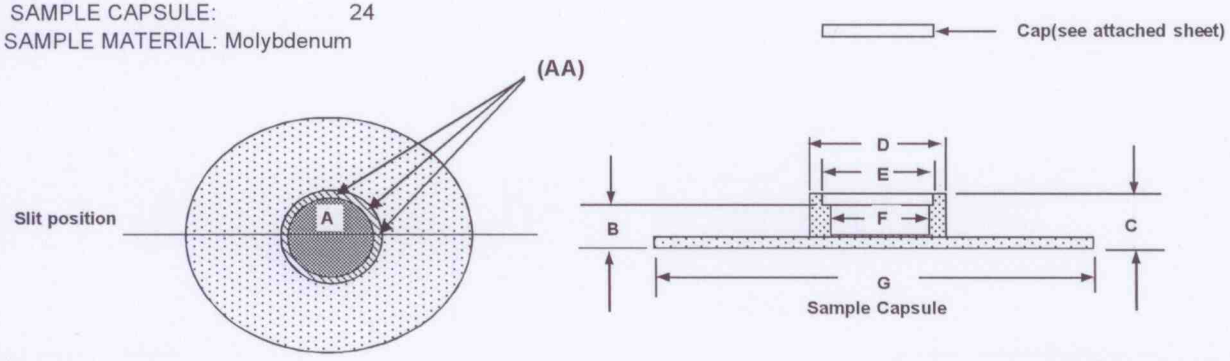
Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00075	3.6	south
2	0.200	0.00030	3.40	
3	0.400	0.00025	3.20	
4	0.600	0.00020	3.00	
5	0.800	0.00015	2.80	
6	1.000	0.00010	2.60	
7	1.200	0.00010	2.40	
8	1.400	0.00000	2.20	
9	1.600	0.00005	2.00	
10	1.800	0.00000	1.80	
11	2.000	0.00000	1.60	
12	2.200	0.00005	1.40	
13	2.400	0.00000	1.20	
14	2.600	-0.00005	1.00	
15	2.800	0.00000	0.80	
16	3.000	-0.00010	0.60	
17	3.200	0.00000	0.40	
18	3.400	-0.00005	0.20	
19	3.600	0.00000	0.00	
20	3.800	-0.00005	-0.20	
21	4.000	0.00000	-0.40	
22	4.200	0.00000	-0.60	
23	4.400	0.00005	-0.80	
24	4.600	0.00000	-1.00	
25	4.800	0.00000	-1.20	
26	5.000	0.00010	-1.40	
27	5.200	0.00010	-1.60	
28	5.400	0.00015	-1.80	
29	5.600	0.00015	-2.00	
30	5.800	0.00020	-2.20	
31	6.000	0.00020	-2.40	
32	6.200	0.00020	-2.60	
33	6.400	0.00030	-2.80	
34	6.600	0.00030	-3.00	
35	6.800	0.00030	-3.20	
36	7.000	0.00035	-3.40	
37	7.200	0.00045	-3.60	north

SHOT No.: 1071 post polish 11/18/2010

SAMPLE CAPSULE: 24

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04065
A	0.04075
A	0.04070
A	0.04065
Avg	0.04069

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3540
F	0.3140
F	0.3140

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17085
C	0.17095
C	0.17095
C	0.17085
D	0.3960
D	0.3955
G	1.7470
G	1.7475
H	0.10151

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14205
B point 2	0.14225
B point 3	0.14200
B point 4	0.14245
B point 5	0.14220
B point 6	0.14215
B point 7	0.14225
B point 8	0.14225

Statistics

N	8
MAX	0.14245
MIN	0.14200
Range	0.00045
Average	0.14220

MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

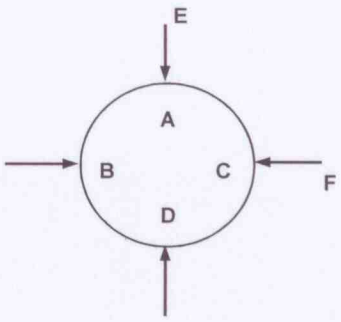
SHOT No. ___1071_____

LGG Moly Capsule Cap 11/18/2010

SAMPLE MATERIAL: Mo 24

Post polish

Thickness	Measurement
A	0.03040
A	0.03055
B	0.03060
B	0.03070
C	0.03080
C	0.03085
D	0.03075
D	0.03070



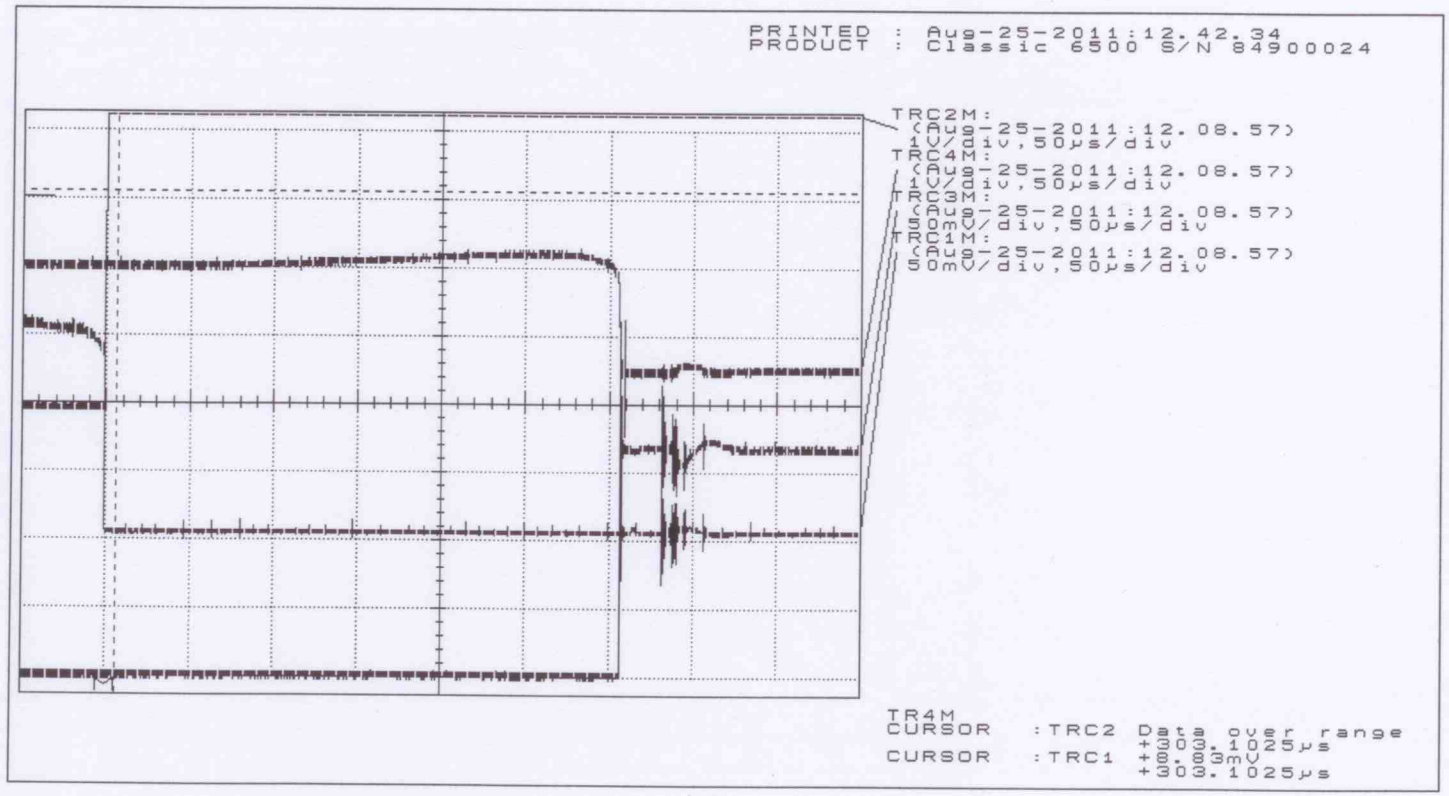
Diameter Measurement	
E	0.35350
E	0.35350
F	0.35350
F	0.35400
AVE	0.35363
Radius	0.1768

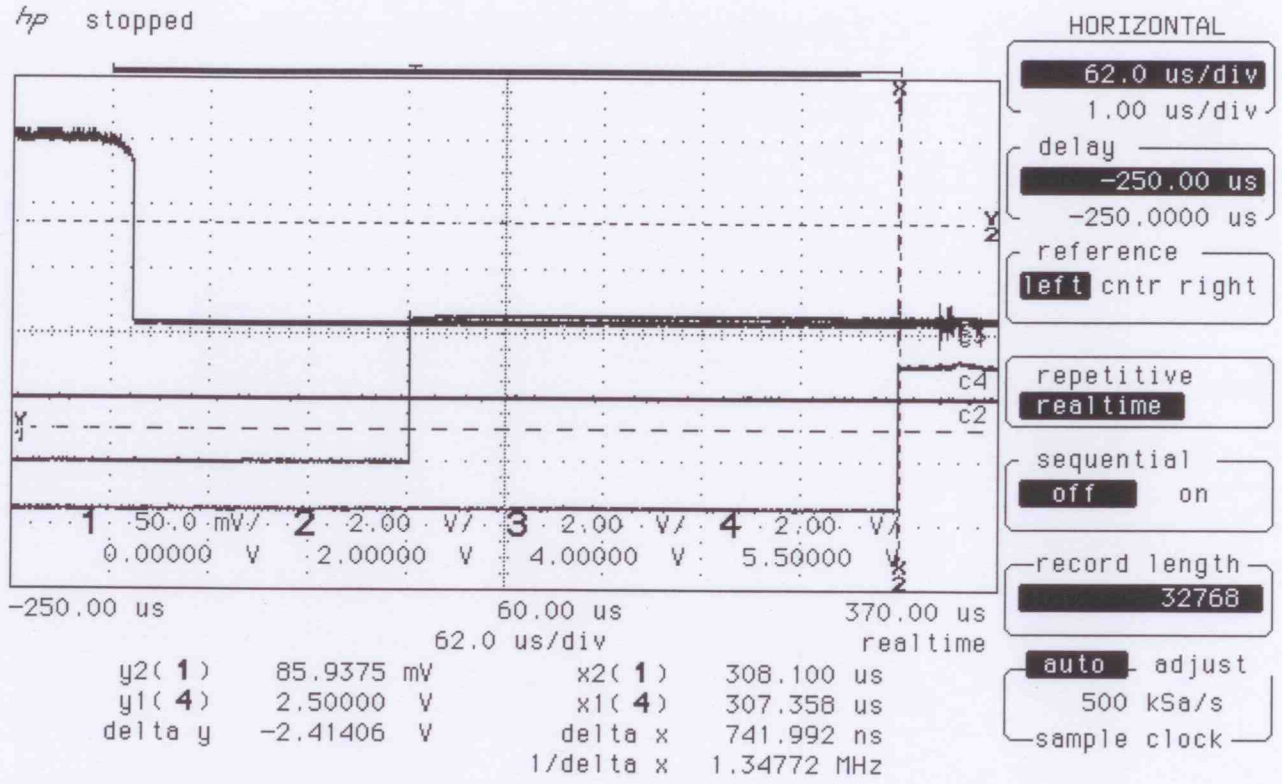
Statistic for thickness	
N	8
MAX	0.03085
MIN	0.0304
Range	0.00045
MEAN	0.03067
STDEV	0.000146232

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.353625
STDEV	0.00025

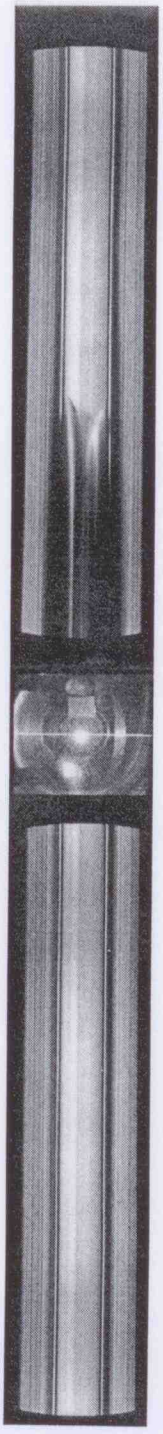
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03066875	±	mm	
	FLATNESS:		0.00045			
	VOLUME:		0.0494		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.0743		$grams/cm^3$	


PRINTED : Aug-25-2011:12.42.34
PRODUCT : Classic 6500 S/N 84900024
TRC2M:
(Aug-25-2011:12.08.57)
1V/div,50µs/div
TRC4M:
(Aug-25-2011:12.08.57)
1V/div,50µs/div
TRC3M:
(Aug-25-2011:12.08.57)
50mV/div,50µs/div
TRC1M:
(Aug-25-2011:12.08.57)
50mV/div,50µs/div
TR4M
CURSOR :TRC2 Data over range
+303.1025µs
CURSOR :TRC1 +8.83mV
+303.1025µs


hp stopped
HORIZONTAL
62.0 us/div
1.00 us/div
delay
-250.00 us
-250.0000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
500 kSa/s
sample clock
c4
c2
1 50.0 mV/ 2 2.00 V/ 3 2.00 V/ 4 2.00 V/
0.00000 V 2.00000 V 4.00000 V 5.50000 V
-250.00 us
60.00 us
62.0 us/div
370.00 us
realtime
y2(1) 85.9375 mV
y1(4) 2.50000 V
delta y -2.41406 V
x2(1) 308.100 us
x1(4) 307.358 us
delta x 741.992 ns
1/delta x 1.34772 MHz

SHOT 1071



f8

40 mm GUN DATA SHEET

Shot No. 1074 Date 9-20-11

Target:

Sample Material: Anorthite - Diopside Mix
Type of Measurement: Preheated EOS 1400°C
Expected Velocity: 1.500 km/sec.

Projectile:

Flyer Material: Mo (#10) Thickness: 0.1000 in. Weight: 20.363 gms.
Projectile Material: LEXAN Length: 2.500 in. Dia: 1.568/1.566 in.
Weight: 97.5757 gms. Corrected Weight: 93.5757 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle
Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400
Main Charge Weight: 131.94 gms. Powder Type: IMR4350 C/M: 1.41

Laser Distances:

Beam I to Muzzle: 68.3/68.3 cm.
Beam II to Muzzle: 43.2 / 43.2 cm.
Beam III to Muzzle: 2.1 / 2.1 cm.
Beam III to Target: 50.867 / 50.857 mm.

Co-axial Pin Height: – in.
Shim Thickness: – in.
Total Height: – cm.
Corrected III to Target Distance: – cm.

Estimated Times:

Beam I to II: 167 µsec.
Beam II to III: 302 µsec.
Beam III to Target: 33.9 µsec.

Actual Beam Distances:

Beam I to II: .02510 m.
Beam II to III: 0.4530 m.
Beam III to Target: 0.050862 m.

Delays:

Xenon Lamp Delay: 4.627 µsec.
X-ray 1 to 2 Interval: 13.874 µsec.

Lamp Triggered by Laser No.: 3
Camera dial 684 for 5112 ns streak

Notes:

Temp: 6min, sig .207, 5.4 kV 1400°C

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: 13.945 µsec.
UDC 311.13 µsec
Counter 6 X-ray interval 13.504 µsec
Tank/Pump Pressure: 120/120 µm.

HP6-1 32.00	ns*	HP5-1 -183.580	µsec	GS7-1 -16.025	µsec
HP6-2 13.996	µsec	HP5-2 -183.626	µsec	GS7-2 -5.905	µs
HP6-3 21.218	µsec	HP5-3 8.00	ns*	GS7-3 295.149	µsec
HP6-4 24.708	µsec	HP5-4 311.208	µsec	GS7-4 305.295	µsec

Measured Shot Velocities:

Velocity, X-ray:_____m/sec.

Backup Velocity, X-ray : _____ m/s
UDC : 1456.0 m/sec

SETUP: SHOT for scopes

HP6

trig : Ch1 xray 1 50V+ (5V/div)

- second hump (above 30V for 30ns) –lvl 10V+

Ch2 xray2 50V+ -(5V/div)

Ch3 cam monitor -- -1.75V - (500mV/div)

Ch4 photodiode—peak brightness—(200mV/div)

TOTAL TIME (from wksht): ~~479~~ us 22.6
Set time 65 us (100 ns/div)
Delay from trig ~~-80~~ -20 us (need: 0)

HP5

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V (2V/div)

Ch1 laser1 analog -- downgoing 150mV (50mV/div)

Ch2 laser 1 TTL, 4V -- level 2.5V+ (2V/ div)

Ch4 laser 3 4V TTL -- jog in sig ~2.5V (2V/div)

TOTAL TIME (from wksht): 479 us
Set time 1310 us (2µs /div)
Delay from trig -600 us (need: -177)

GS7

trig : Ch2 laser 2 TTL -- 4V+ (1V/div)

Ch1 laser 2 analog -- -150mV (50mV/div)

Ch3 laser 3 analog -- -150mV(50mV/div)

Ch4 laser 3 TTL –4V+ (1V/div)

TOTAL TIME (from wksht): 302 us
Set time 1000 us (M: 100 us)
Pretrigger view 9 %

40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: 13.632 µsec.
UDC 221.07 µsec
Counter 6 X-ray interval 13.281 µsec

HP6-1 -50.80 ns*
HP6-2 13.580 µsec
HP6-3 14.820 µsec
HP6-4 17.878 µsec*?

HP5-1 -2.110 µsec
HP5-2 218.712 µsec
HP5-3 17.00 ns*
HP5-4 220.874 µsec

Measured Shot Velocities:

UDC : 2049.11 m/sec
Cal frequency 24.7525 MHz ..2nd.

SETUP: SIM for scopes

HP6

trig : Ch1 xray 1 50V+ (5V/div)

- second hump (above 30V for 30ns) –lvl 10V+

Ch2 xray2 50V+ -(5V/div)

Ch3 cam monitor -- -1.75V - (500mV/div)

Ch4 photodiode—peak brightness—(200mV/div)

TOTAL TIME (from wksht) 22.6 us

Set time 65 us (100 ns/div)

Delay from trig ~~-40~~ -20 us (need: 0)

HP5

trig Ch3 laser 2 5V TTL -- jog in sig ~2.5V (2V/div)

Ch1 Mag sim 1 -- zero crossing (6V) (2V/div)

Ch2 Mag sim 2 (2V/div)

Ch4 laser 3 5V TTL -- jog in sig ~2.5V (2V/div)

TOTAL TIME (from wksht) 304 us

Set time 1310 us (2µs ns/div)

Delay from trig -600 us (need: -2)

40 mm hot EOS shot Nominal Timeline Preshot 1074

V	1500				
cable time	75	ch1	ch2	Laser1-Laser2 distance	0.251
photodiode intrinsic delays	[redacted]			Laser2-Laser3 distance	0.453
UDC extra count lag	118	2140	2140	Laser3-target distance	0.050862
pulse translator delay	150			Laser3-target fudge	0.032294
X-ray 1 program delay	0	971	X-ray 1 delay amp intrinsic	Laser3-Xray2 % of Laser3-target	75
X-ray 2 program delay	13874	1216	X-ray 2 delay amp intrinsic		
X-ray 1 pulser delay	426			Us(Mo)	5904.01699
X-ray 2 pulser delay	887			driver thickness	0.00111252
amp trigger to peak bright	[redacted]			sample thickness	0.00254
HV3 program delay	-4627			cap thickness	0.00076403
Camera intrinsic delay	107			estimated sample+cover time	600.844235
Streak duration	5000				
1 dead streak before driver	2000				

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-167333	-0.251		Laser 1 actual interrupt		HP5-1
-167133	-0.2507		Laser 1 TTL out		
-167058	-0.2505875		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
10178	0.015267		Laser 2 TTL out (shot)		GS7-2 & Trig
8113	0.0121695		Magnet Sim 1 analog (sim)	HP5-1	
10253	0.0153795		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
302000	0.453		Laser 3 actual interrupt		GS7-3
312191	0.4682865		Laser 3 TTL out		GS7-4
310126	0.465189		Magnet Sim 2 analog (sim)	HP5-2	
312266	0.468399		Laser 3 TTL at UDC (start down-count) and pulse transla	HP5-4, UDC stop	HP5-4, UDC stop
312491	0.4687365		Pulse translator out reaches X-ray delay amps 1 & 2		
313462	0.470193		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
313888	0.470832		X-ray 1 fires		
313963	0.4709445		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
327581	0.4913715		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
328468	0.4911465		X-ray 2 fires		
328543	0.4928145		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
329287	0.49393115		HV3 out to lamp		
333914	0.50087165		UDC zero time, HV1 out to camera		
333989	0.50098415		Trigger at camera		
334096	0.50114465		Begin Streak		
334171	0.50125715		Camera Monitor reaches control lab	HP6-3	HP6-3
336564	0.50484665		Lamp Peak Bright	HP6-4	HP6-4
335908	0.503862	0	IMPACT		
336096		0.00111252	Driver arrival on streak	Driver cutoff on streak	2000
336697		0.004659915	Sample cutoff on streak	Sample cutoff on sreak	2601
339096		0.018824571	End Streak		

	rho0	Co	s		
Cold Mo	10206	5033	1.28946405		
Hot Mo	9937	4918.5831	1.28837124	1407	
Liquid An-Hd	[redacted]				

				up	P	Us
driver	357.7250824	-139723569	1.06661E+11	764.867969	44.8734399	**5904.01699**
sample	8950.248646	-95769072	1.04726E+11	1236.3956	15.4389312	**4477.74688**
cap	-8950.24865	-75651895	42655673537	530.540782	29.5342676	**5602.11658**

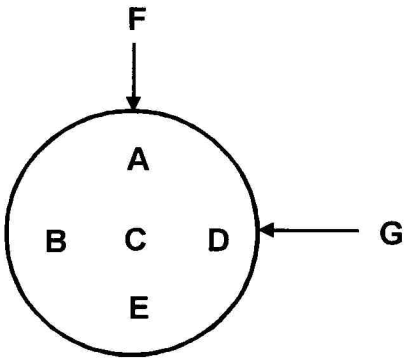
Cold Mo	10206	5033	1.28946405	
Hot Mo	9961.5	4927.8728	1.288702471	1300
	9937	4918.5831	1.28837124	1407
	9913	4908.7717	1.2882417	1508
	9875	4893.13	1.28807834	1659

	SIM	SHOT		
HP5 1	-2140	-177586		
HP5 2	299873	-177311		
HP5 3	0	0		
HP5 4	302013	302013	479599	304153
UDC upcount:	302013	302013		
HP6 1	0	0		
HP6 2	14580	14580		
HP6 3	20208	20208		
HP6 4	22601	22601		
GS7 1		-275		
GS7 2		0		
GS7 3		291822		
GS7 4		302013		
Counter 4b:	14580	14580		
Counter 6:	14119	14119		

SHOT No. 1074

FLYER PLATE MATERIAL: **Mo #10** 6/28/2011

Measurement done by: Russ



DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.10060	F	1.24950
A	0.10055	F	1.24950
B	0.10045	G	1.24950
B	0.10040	G	1.24950
C	0.10040		
C	0.10045		
D	0.10040		
D	0.10035		
E	0.10030		
E	0.10020		

Statistic for thickness

N	10
MAX	0.10055
MIN	0.10020
Range	0.00035
MEAN	0.100428571
	2.550885714
STDEV	6.36209E-05

Statistic for Diameter (F-G)

N	4	
MAX	1.24950	
MIN	1.24950	
Range	0.00000	
MEAN	1.2495000	inch
	31.7373000	mm
STDEV	0	

	Sample in Air	Crystal Density	
1	20.3633	10.129	
2	20.36340	10.137	
3	20.36320	10.142	

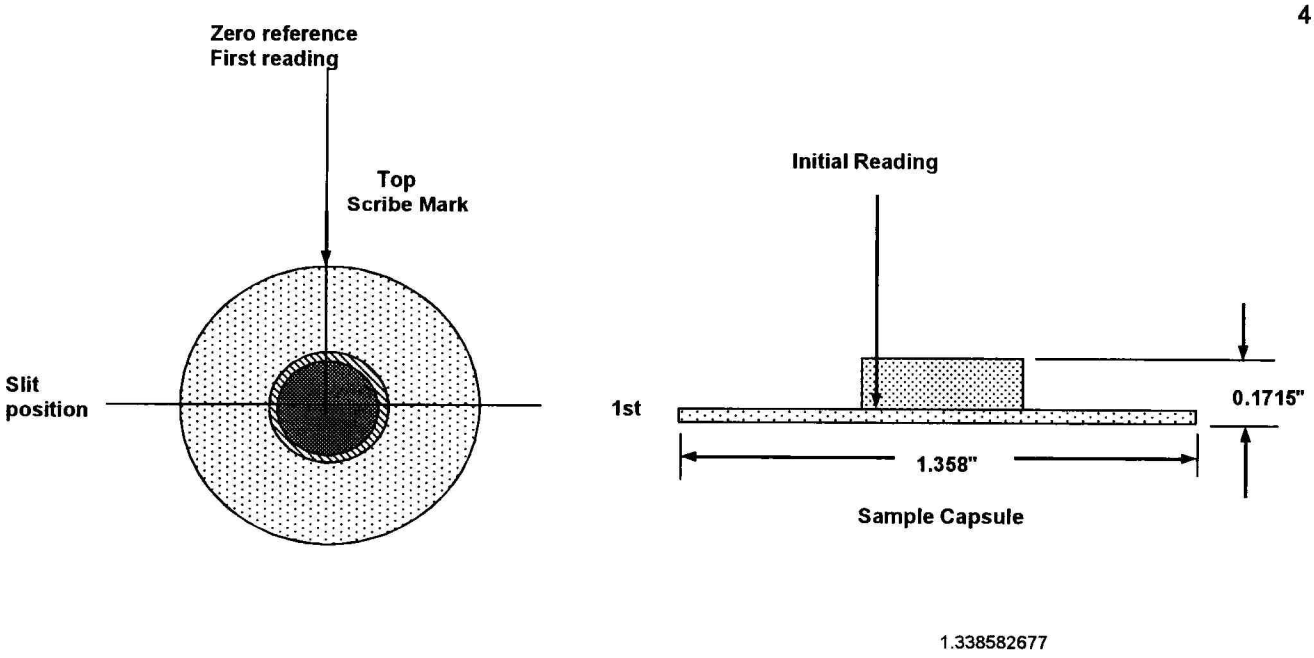
Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.100428571	±	in
FLATNESS:	0.00035	in.	
VOLUME:	2.0180	1.62E-04	cm^3
CRYSTAL DENSITY:	10.1360	#DIV/0!	$grams/cm^3$
BULK DENSITY:	10.0908	#DIV/0!	$grams/cm^3$
DENSITIES CHECKED BY: _____		on _____	
MEASUREMENT CHECKED E	Russ	6/28/2011	

SAMPLE CAPSULE **22**
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

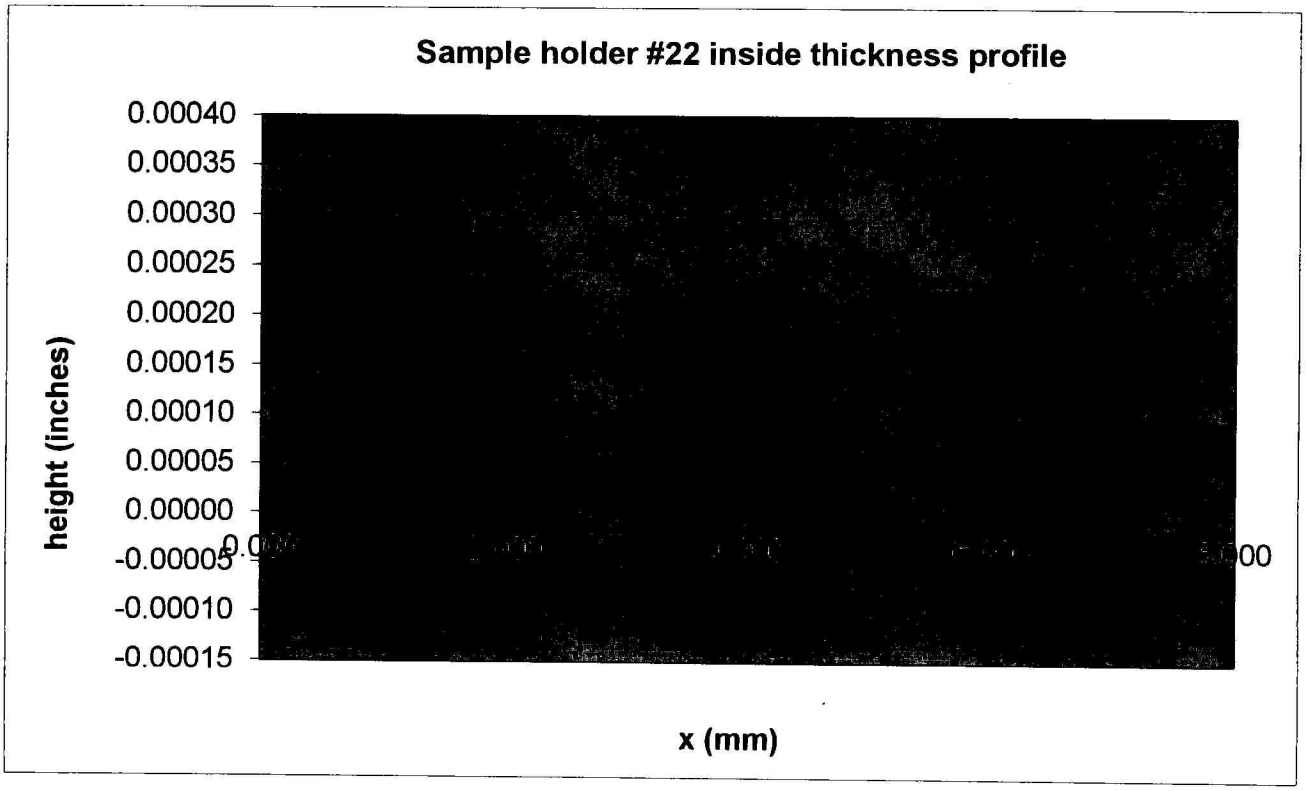
4.683
4.623



1.338582677

Average thickness reading = 0.00003

Note: The thickness of the reference zero point from the base is = **0.04240** Inches
1.07696 mm



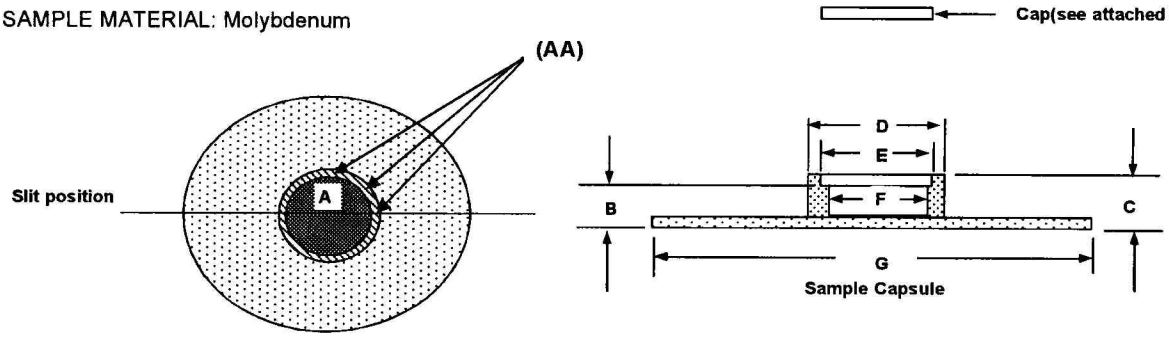
Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00025	3.6	south
2	0.200	0.00025	3.40	
3	0.400	0.00020	3.20	
4	0.600	0.00020	3.00	
5	0.800	0.00010	2.80	
6	1.000	0.00005	2.60	
7	1.200	0.00005	2.40	
8	1.400	0.00000	2.20	
9	1.600	-0.00005	2.00	
10	1.800	-0.00005	1.80	
11	2.000	-0.00005	1.60	
12	2.200	-0.00005	1.40	
13	2.400	0.00000	1.20	
14	2.600	-0.00010	1.00	
15	2.800	-0.00010	0.80	
16	3.000	-0.00005	0.60	
17	3.200	-0.00005	0.40	
18	3.400	0.00000	0.20	
19	3.600	0.00000	0.00	
20	3.800	-0.00005	-0.20	
21	4.000	0.00000	-0.40	
22	4.200	-0.00005	-0.60	
23	4.400	-0.00010	-0.80	
24	4.600	-0.00005	-1.00	
25	4.800	-0.00005	-1.20	
26	5.000	-0.00010	-1.40	
27	5.200	-0.00005	-1.60	
28	5.400	-0.00005	-1.80	
29	5.600	-0.00005	-2.00	
30	5.800	0.00005	-2.20	
31	6.000	0.00005	-2.40	
32	6.200	0.00010	-2.60	
33	6.400	0.00015	-2.80	
34	6.600	0.00020	-3.00	
35	6.800	0.00025	-3.20	
36	7.000	0.00030	-3.40	
37	7.200	0.00035	-3.60	north

SHOT No.: 1074 post polish 11/18/2010

SAMPLE CAPSULE: 22

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04130
A	0.04120
A	0.04120
A	0.04130
Avg	0.04125

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3535
E	0.3540
F	0.3140
F	0.3140

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17145
C	0.17185
C	0.17175
C	0.17165
D	0.3960
D	0.3960
G	1.7480
G	1.7480
H	0.10121

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14255
B point 2	0.14250
B point 3	0.14250
B point 4	0.14245
B point 5	0.14240
B point 6	0.14240
B point 7	0.14240
B point 8	0.14250

Statistics

N	8
MAX	0.14255
MIN	0.14240
Range	0.00015
Average	0.14246

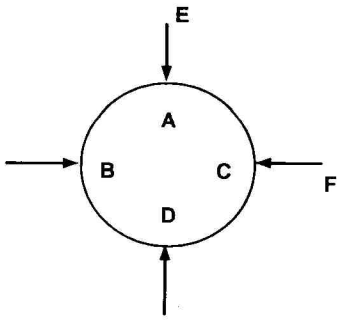
MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

SHOT No. _____1074_____
LGG Moly Capsule Cap
SAMPLE MATERIAL: Mo 22

11/18/2010

Post polish

Thickness Measurement	
A	0.03045
A	0.03050
B	0.03060
B	0.03055
C	0.03055
C	0.03055
D	0.03060
D	0.03055



Diameter Measurement	
E	0.35350
E	0.35400
F	0.35350
F	0.35350
AVE	0.35363
Radius	0.1768

Statistic for thickness	
N	8
MAX	0.03060
MIN	0.0305
Range	0.00015
MEAN	0.03054
STDEV	4.95516E-05

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.3535
Range	0.0005
MEAN	0.353625
STDEV	0.00025

post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03054375	±	mm	
	FLATNESS:		0.00015			
	VOLUME:		0.0492		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.1155		$grams/cm^3$	

SHOT No. ____ _____ tip used: .7mm long/ flat tip

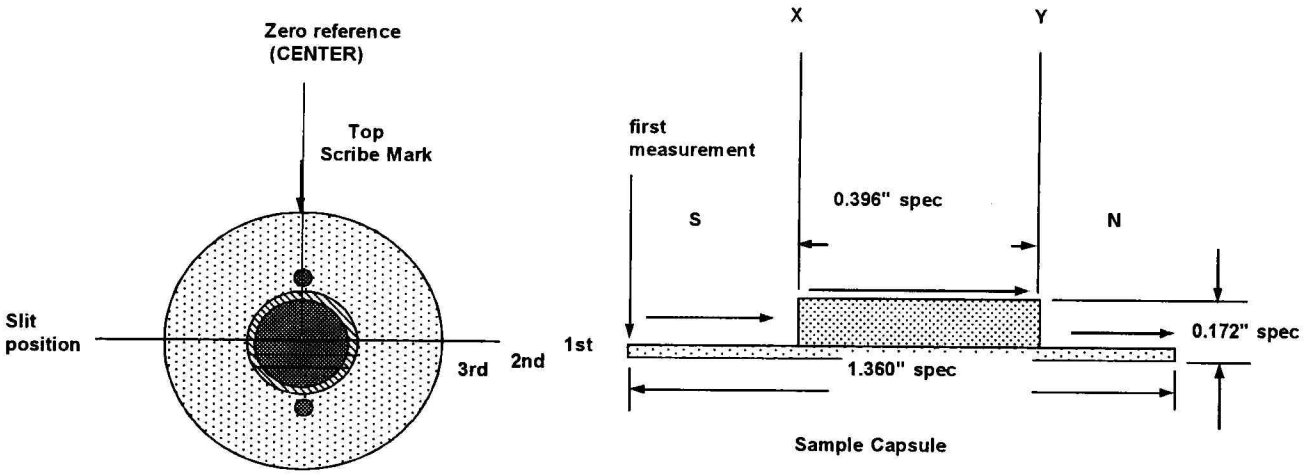
SAMPLE CAPSULE: 22 note: the platform on which the measurement was taken

SAMPLE MATERIAL: An-Di deviates from flat by +0.013 max.

direction of measurement

0.0521

THICKNESS PROFILE (Not re-polished, but final surface) 1.792



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = 0.00056

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = 0.00054

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

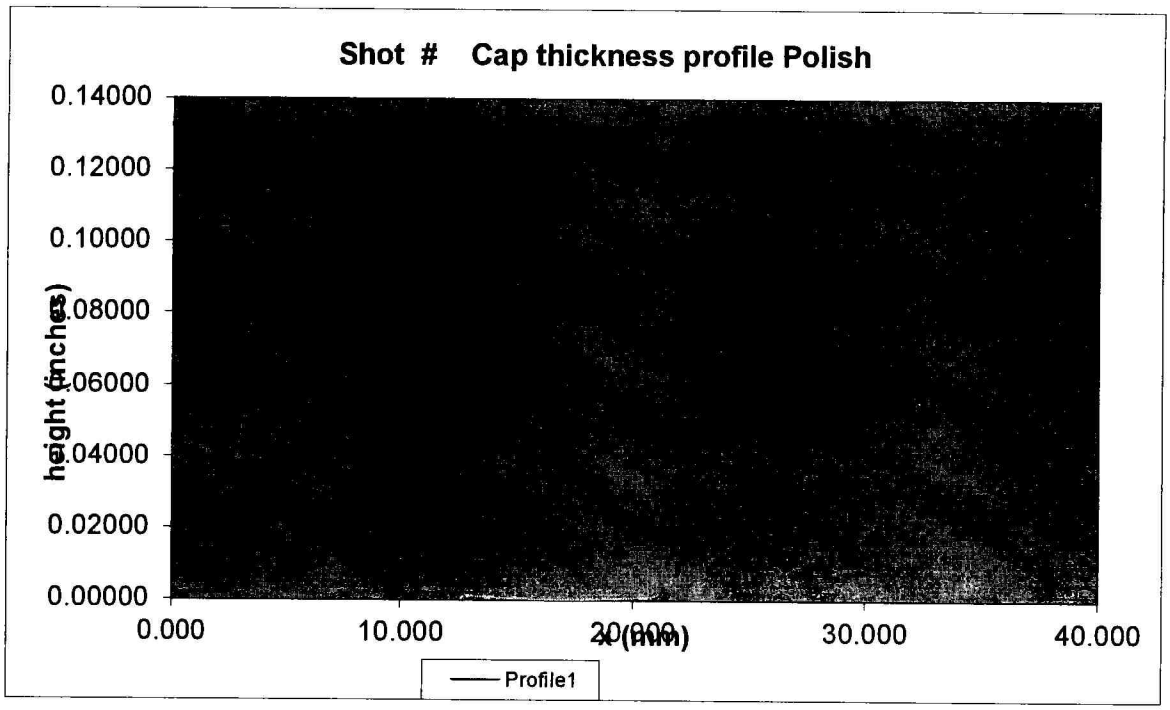
Average thickness reading = 0.00048

Note: Measurement from reference zero point from the base is = **-0.1782** Inches
-4.5263 mm

Average thickness of the driver Plate = -0.0458 Inches
-1.1623 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.14000
0.12000
0.10000
0.08000
0.06000
0.04000
0.02000
0.00000
height (inches)
0.000
10.000
20.000
30.000
40.000
x (mm)
Profile1

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Bel

3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

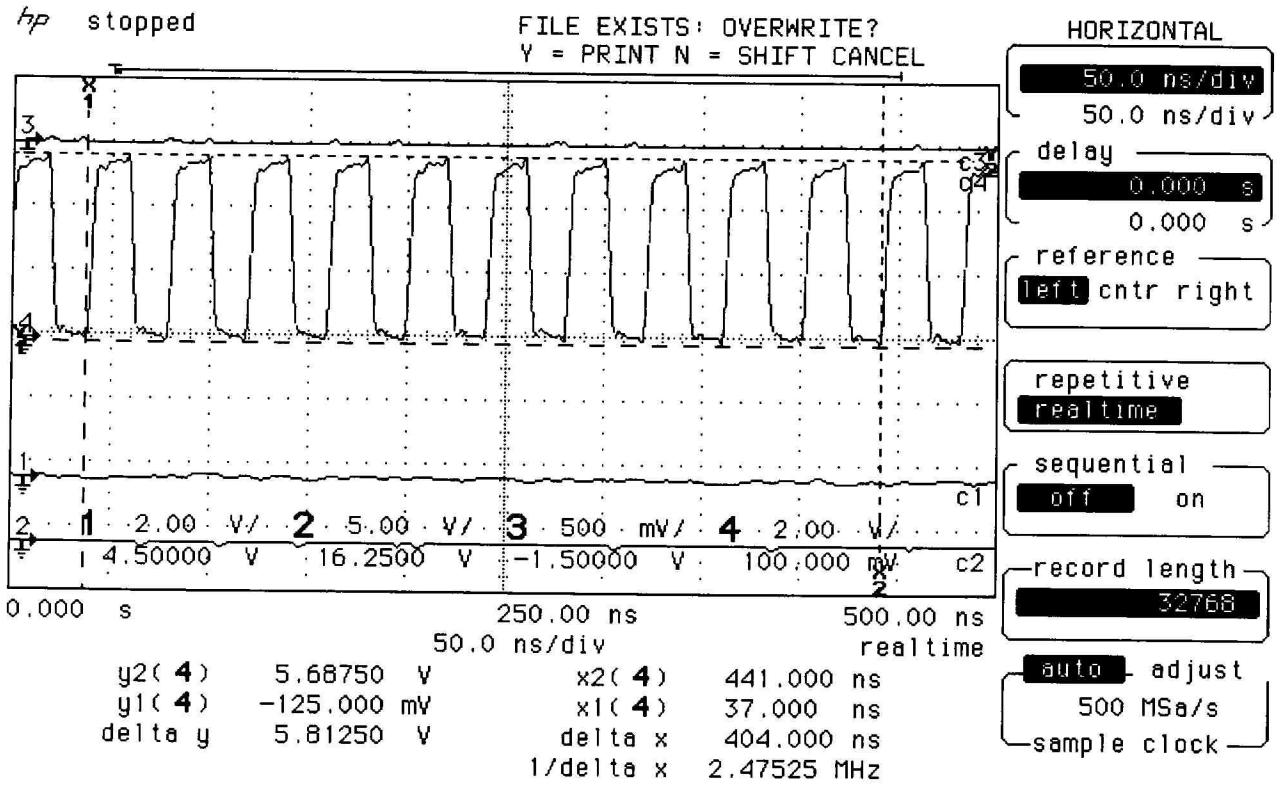
Number	Reading	abs dist.		Number	Reading	abs dist.	
3	Distance			of	Distance		
Reading	mm	mm	South (left side)	Reading	mm	mm	North(right
1	0.000	17.000	0.1326	225	22.400	-5.400	0.1312
2	0.100	16.900	0.1326	226	22.500	-5.500	0.1325
3	0.200	16.800	0.1326	227	22.600	-5.600	0.1325
4	0.300	16.700	0.1326	228	22.700	-5.700	0.1325
5	0.400	16.600	0.1326	229	22.800	-5.800	0.1325
6	0.500	16.500	0.1326	230	22.900	-5.900	0.1325
7	0.600	16.400	0.1326	231	23.000	-6.000	0.1325
8	0.700	16.300	0.1326	232	23.100	-6.100	0.1325
9	0.800	16.200	0.1326	233	23.200	-6.200	0.1325
10	0.900	16.100	0.1326	234	23.300	-6.300	0.1325
11	1.000	16.000	0.1327	235	23.400	-6.400	0.1325
12	1.100	15.900	0.1327	236	23.500	-6.500	0.1325
13	1.200	15.800	0.1327	237	23.600	-6.600	0.1325
14	1.300	15.700	0.1327	238	23.700	-6.700	0.1325
15	1.400	15.600	0.1327	239	23.800	-6.800	0.1325
16	1.500	15.500	0.1327	240	23.900	-6.900	0.1325
17	1.600	15.400	0.1327	241	24.000	-7.000	0.1325
18	1.700	15.300	0.1327	242	24.100	-7.100	0.1325
19	1.800	15.200	0.1327	243	24.200	-7.200	0.1325
20	1.900	15.100	0.1327	244	24.300	-7.300	0.1325
21	2.000	15.000	0.1328	245	24.400	-7.400	0.1324
22	2.100	14.900	0.1327	246	24.500	-7.500	0.1325
23	2.200	14.800	0.1328	247	24.600	-7.600	0.1324
24	2.300	14.700	0.1328	248	24.700	-7.700	0.1325
25	2.400	14.600	0.1328	249	24.800	-7.800	0.1325
26	2.500	14.500	0.1328	250	24.900	-7.900	0.1325
27	2.600	14.400	0.1328	251	25.000	-8.000	0.1325
28	2.700	14.300	0.1328	252	25.100	-8.100	0.1325
29	2.800	14.200	0.1328	253	25.200	-8.200	0.1325
30	2.900	14.100	0.1328	254	25.300	-8.300	0.1325
31	3.000	14.000	0.1328	255	25.400	-8.400	0.1325
32	3.100	13.900	0.1328	256	25.500	-8.500	0.1325
33	3.200	13.800	0.1328	257	25.600	-8.600	0.1324
34	3.300	13.700	0.1328	258	25.700	-8.700	0.1325
35	3.400	13.600	0.1329	259	25.800	-8.800	0.1324
36	3.500	13.500	0.1328	260	25.900	-8.900	0.1324
37	3.600	13.400	0.1328	261	26.000	-9.000	0.1324
38	3.700	13.300	0.1328	262	26.100	-9.100	0.1324
39	3.800	13.200	0.1328	263	26.200	-9.200	0.1325
40	3.900	13.100	0.1328	264	26.300	-9.300	0.1324
41	4.000	13.000	0.1328	265	26.400	-9.400	0.1324
42	4.100	12.900	0.1329	266	26.500	-9.500	0.1324
43	4.200	12.800	0.1329	267	26.600	-9.600	0.1324
44	4.300	12.700	0.1329	268	26.700	-9.700	0.1324
45	4.400	12.600	0.1329	269	26.800	-9.800	0.1324
46	4.500	12.500	0.1329	270	26.900	-9.900	0.1324
47	4.600	12.400	0.1329	271	27.000	-10.000	0.1324
48	4.700	12.300	0.1329	272	27.100	-10.100	0.1324
49	4.800	12.200	0.1329	273	27.200	-10.200	0.1324
50	4.900	12.100	0.1329	274	27.300	-10.300	0.1323
51	5.000	12.000	0.1329	275	27.400	-10.400	0.1323
52	5.100	11.900	0.1329	276	27.500	-10.500	0.1324
53	5.200	11.800	0.1329	277	27.600	-10.600	0.1323

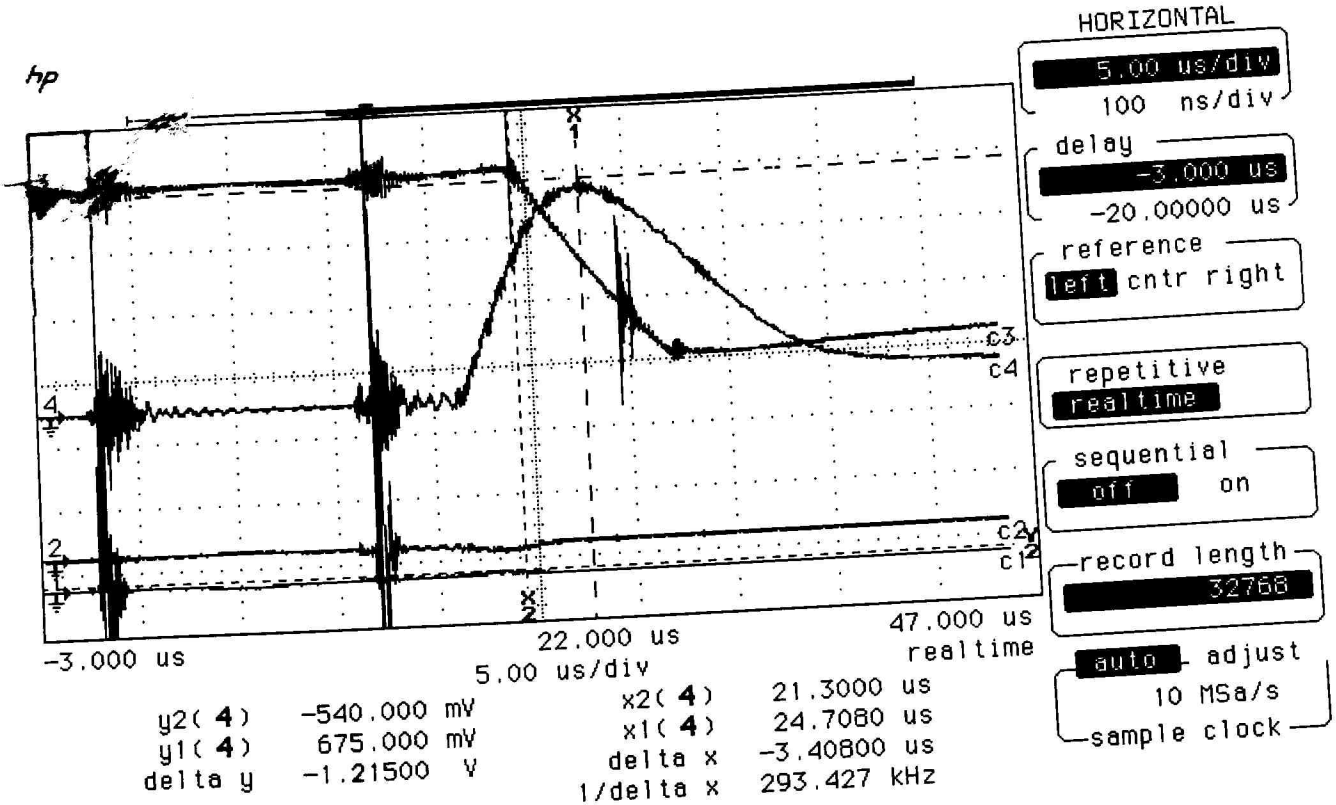
54	5.300	11.700	0.1329	278	27.700	-10.700	0.1323
55	5.400	11.600	0.1329	279	27.800	-10.800	0.1323
56	5.500	11.500	0.1329	280	27.900	-10.900	0.1323
57	5.600	11.400	0.1329	281	28.000	-11.000	0.1323
58	5.700	11.300	0.1329	282	28.100	-11.100	0.1323
59	5.800	11.200	0.1329	283	28.200	-11.200	0.1322
60	5.900	11.100	0.1329	284	28.300	-11.300	0.1322
61	6.000	11.000	0.1329	285	28.400	-11.400	0.1323
62	6.100	10.900	0.1329	286	28.500	-11.500	0.1322
63	6.200	10.800	0.1329	287	28.600	-11.600	0.1322
64	6.300	10.700	0.1329	288	28.700	-11.700	0.1322
65	6.400	10.600	0.1329	289	28.800	-11.800	0.1322
66	6.500	10.500	0.1329	290	28.900	-11.900	0.1322
67	6.600	10.400	0.1329	291	29.000	-12.000	0.1322
68	6.700	10.300	0.1329	292	29.100	-12.100	0.1322
69	6.800	10.200	0.1329	293	29.200	-12.200	0.1322
70	6.900	10.100	0.1329	294	29.300	-12.300	0.1322
71	7.000	10.000	0.1329	295	29.400	-12.400	0.1321
72	7.100	9.900	0.1329	296	29.500	-12.500	0.1321
73	7.200	9.800	0.1329	297	29.600	-12.600	0.1322
74	7.300	9.700	0.1329	298	29.700	-12.700	0.1321
75	7.400	9.600	0.1329	299	29.800	-12.800	0.1321
76	7.500	9.500	0.1329	300	29.900	-12.900	0.1321
77	7.600	9.400	0.1329	301	30.000	-13.000	0.1321
78	7.700	9.300	0.1329	302	30.100	-13.100	0.1321
79	7.800	9.200	0.1329	303	30.200	-13.200	0.1321
80	7.900	9.100	0.1329	304	30.300	-13.300	0.1320
81	8.000	9.000	0.1329	305	30.400	-13.400	0.1320
82	8.100	8.900	0.1329	306	30.500	-13.500	0.1320
83	8.200	8.800	0.1329	307	30.600	-13.600	0.1320
84	8.300	8.700	0.1329	308	30.700	-13.700	0.1320
85	8.400	8.600	0.1329	309	30.800	-13.800	0.1320
86	8.500	8.500	0.1329	310	30.900	-13.900	0.1320
87	8.600	8.400	0.1329	311	31.000	-14.000	0.1320
88	8.700	8.300	0.1328	312	31.100	-14.100	0.1319
89	8.800	8.200	0.1328	313	31.200	-14.200	0.1319
90	8.900	8.100	0.1328	314	31.300	-14.300	0.1319
91	9.000	8.000	0.1328	315	31.400	-14.400	0.1319
92	9.100	7.900	0.1328	316	31.500	-14.500	0.1319
93	9.200	7.800	0.1328	317	31.600	-14.600	0.1319
94	9.300	7.700	0.1328	318	31.700	-14.700	0.1319
95	9.400	7.600	0.1328	319	31.800	-14.800	0.1318
96	9.500	7.500	0.1328	320	31.900	-14.900	0.1318
97	9.600	7.400	0.1328	321	32.000	-15.000	0.1318
98	9.700	7.300	0.1328	322	32.100	-15.100	0.1318
99	9.800	7.200	0.1328	323	32.200	-15.200	0.1318
100	9.900	7.100	0.1328	324	32.300	-15.300	0.1317
101	10.000	7.000	0.1328	325	32.400	-15.400	0.1318
102	10.100	6.900	0.1327	326	32.500	-15.500	0.1317
103	10.200	6.800	0.1327	327	32.600	-15.600	0.1317
104	10.300	6.700	0.1328	328	32.700	-15.700	0.1317
105	10.400	6.600	0.1328	329	32.800	-15.800	0.1317
106	10.500	6.500	0.1327	330	32.900	-15.900	0.1316
107	10.600	6.400	0.1327	331	33.000	-16.000	0.1316
108	10.700	6.300	0.1327	332	33.100	-16.100	0.1316
109	10.800	6.200	0.1327	333	33.200	-16.200	0.1316
110	10.900	6.100	0.1328	334	33.300	-16.300	0.1316
111	11.000	6.000	0.1327	335	33.400	-16.400	0.1315
112	11.100	5.900	0.1327	336	33.500	-16.500	0.1315
113	11.200	5.800	0.1327	337	33.600	-16.600	0.1315
114	11.300	5.700	0.1327	338	33.700	-16.700	0.1315
115	11.400	5.600	0.1327	339	33.800	-16.800	0.1314
116	11.500	5.500	0.1317	340	33.900	-16.900	0.1314
117	11.600	5.400	0.1302	341	34.000	-17.000	0.1314

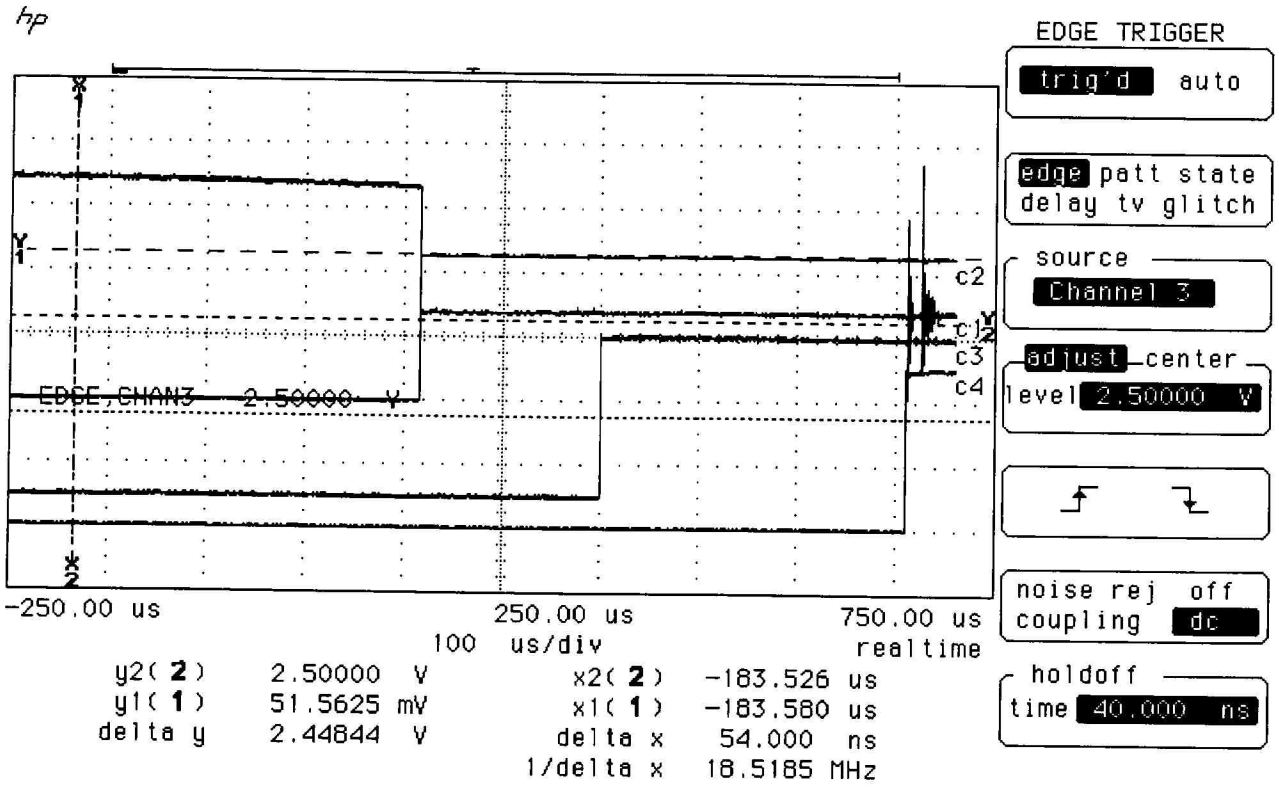
ɔw the center with 0.100 MM increment

Number of Reading	Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
118	11.700	5.300			
119	11.800	5.200			
120	11.900	5.100			
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	0.00245		
125	12.400	4.600	0.00220		
126	12.500	4.500	0.00190	0.00200	
127	12.600	4.400	0.00150	0.00150	
128	12.700	4.300	0.00125	0.00125	
129	12.800	4.200	0.00110	0.00125	...
130	12.900	4.100	0.00105	0.00120	0.00125
131	13.000	4.000	0.00100	0.00105	0.00110
132	13.100	3.900	0.00100	0.00110	0.00115
133	13.200	3.800	0.00090	0.00100	0.00105
134	13.300	3.700	0.00090	0.00095	0.00100
135	13.400	3.600	0.00085	0.00090	0.00095
136	13.500	3.500	0.00080	0.00085	0.00090
137	13.600	3.400	0.00075	0.00085	0.00090
138	13.700	3.300	0.00070	0.00080	0.00085
139	13.800	3.200	0.00070	0.00075	0.00080
140	13.900	3.100	0.00065	0.00075	0.00080
141	14.000	3.000	0.00065	0.00065	0.00070
142	14.100	2.900	0.00060	0.00065	0.00070
143	14.200	2.800	0.00055	0.00060	0.00065
144	14.300	2.700	0.00050	0.00055	0.00060
145	14.400	2.600	0.00050	0.00055	0.00060
146	14.500	2.500	0.00045	0.00050	0.00055
147	14.600	2.400	0.00040	0.00045	0.00050
148	14.700	2.300	0.00045	0.00045	0.00050
149	14.800	2.200	0.00040	0.00040	0.00045
150	14.900	2.100	0.00035	0.00040	0.00045
151	15.000	2.000	0.00035	0.00035	0.00040
152	15.100	1.900	0.00030	0.00035	0.00040
153	15.200	1.800	0.00035	0.00030	0.00035
154	15.300	1.700	0.00025	0.00035	0.00040
155	15.400	1.600	0.00025	0.00030	0.00035
156	15.500	1.500	0.00025	0.00030	0.00035
157	15.600	1.400	0.00025	0.00025	0.00030
158	15.700	1.300	0.00020	0.00020	0.00025
159	15.800	1.200	0.00015	0.00020	0.00025
160	15.900	1.100	0.00015	0.00020	0.00025
161	16.000	1.000	0.00015	0.00015	0.00020
162	16.100	0.900	0.00015	0.00020	0.00025
163	16.200	0.800	0.00010	0.00010	0.00015
164	16.300	0.700	0.00005	0.00015	0.00020
165	16.400	0.600	0.00005	0.00010	0.00015
166	16.500	0.500	0.00005	0.00010	0.00015
167	16.600	0.400	0.00005	0.00010	0.00015
168	16.700	0.300	0.00005	0.00010	0.00015
169	16.800	0.200	0.00005	0.00005	0.00010
170	16.900	0.100	0.00000	0.00010	0.00015

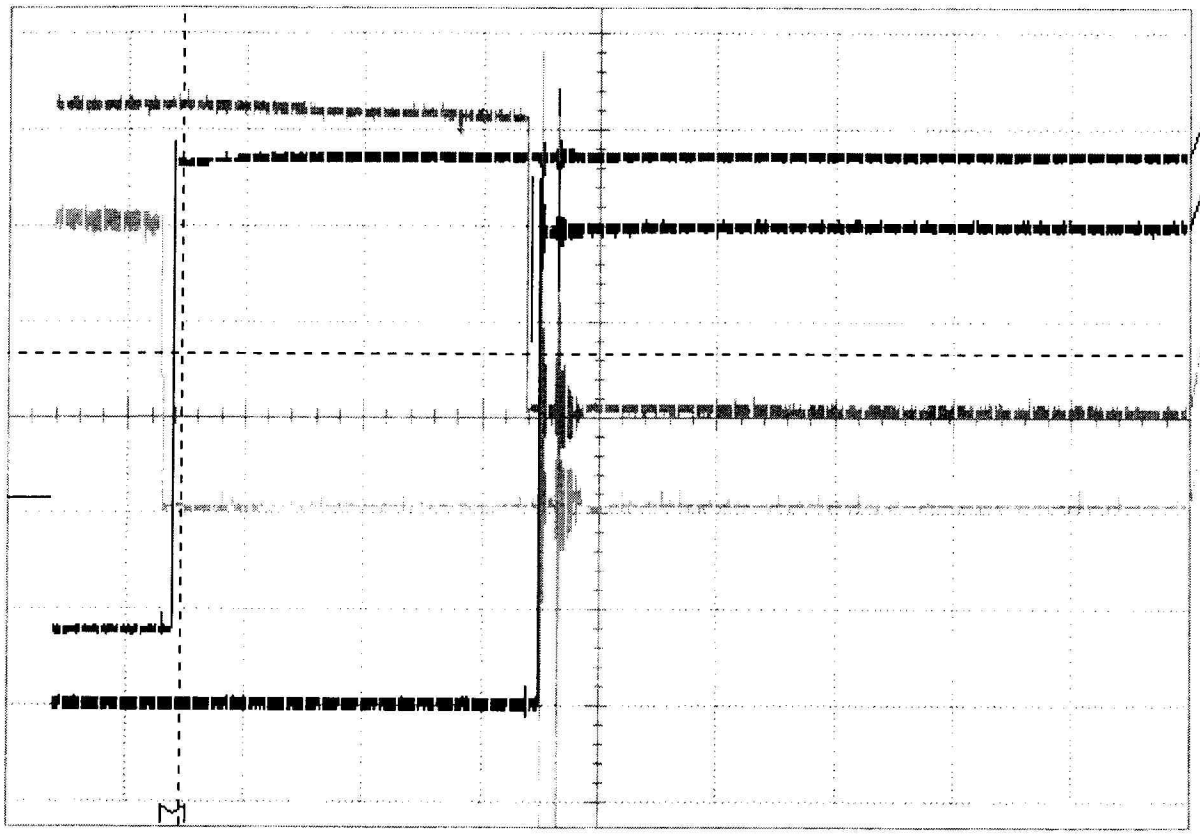
171	17.000	0.000	0.00000	0.00005	0.00010
172	17.100	-0.100	0.00005	0.00010	0.00015
173	17.200	-0.200	0.00000	0.00005	0.00010
174	17.300	-0.300	0.00000	0.00010	0.00015
175	17.400	-0.400	0.00000	0.00010	0.00015
176	17.500	-0.500	0.00005	0.00005	0.00010
177	17.600	-0.600	0.00005	0.00010	0.00015
178	17.700	-0.700	0.00005	0.00005	0.00010
179	17.800	-0.800	0.00005	0.00010	0.00015
180	17.900	-0.900	0.00005	0.00010	0.00015
181	18.000	-1.000	0.00010	0.00010	0.00015
182	18.100	-1.100	0.00010	0.00010	0.00015
183	18.200	-1.200	0.00010	0.00010	0.00015
184	18.300	-1.300	0.00010	0.00015	0.00020
185	18.400	-1.400	0.00015	0.00015	0.00020
186	18.500	-1.500	0.00010	0.00015	0.00020
187	18.600	-1.600	0.00020	0.00015	0.00020
188	18.700	-1.700	0.00020	0.00020	0.00025
189	18.800	-1.800	0.00020	0.00020	0.00025
190	18.900	-1.900	0.00025	0.00025	0.00030
191	19.000	-2.000	0.00025	0.00030	0.00035
192	19.100	-2.100	0.00025	0.00025	0.00030
193	19.200	-2.200	0.00025	0.00030	0.00035
194	19.300	-2.300	0.00025	0.00035	0.00040
195	19.400	-2.400	0.00035	0.00035	0.00040
196	19.500	-2.500	0.00030	0.00035	0.00040
197	19.600	-2.600	0.00035	0.00040	0.00045
198	19.700	-2.700	0.00040	0.00045	0.00050
199	19.800	-2.800	0.00040	0.00045	0.00050
200	19.900	-2.900	0.00045	0.00045	0.00050
201	20.000	-3.000	0.00045	0.00050	0.00055
202	20.100	-3.100	0.00045	0.00055	0.00060
203	20.200	-3.200	0.00055	0.00055	0.00060
204	20.300	-3.300	0.00055	0.00060	0.00065
205	20.400	-3.400	0.00060	0.00065	0.00070
206	20.500	-3.500	0.00065	0.00065	0.00070
207	20.600	-3.600	0.00065	0.00065	0.00070
208	20.700	-3.700	0.00070	0.00075	0.00080
209	20.800	-3.800	0.00070	0.00075	0.00080
210	20.900	-3.900	0.00080	0.00080	0.00085
211	21.000	-4.000	0.00085	0.00085	0.00090
212	21.100	-4.100	0.00085	0.00095	0.00100
213	21.200	-4.200	0.00095	0.00120	0.00125
214	21.300	-4.300	0.00155	0.00185	0.00190
215	21.400	-4.400	0.00210	0.00265	
216	21.500	-4.500	0.00255	0.00255	
217	21.600	-4.600	0.00220	0.00205	
218	21.700	-4.700	0.00195		
219	21.800	-4.800	0.00185		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			


hp stopped
FILE EXISTS: OVERWRITE?
Y = PRINT N = SHIFT CANCEL
HORIZONTAL
50.0 ns/div
50.0 ns/div
delay
0.000 s
0.000 s
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
500 MSa/s
sample clock
1 2.00 V/ 2 5.00 V/ 3 500 mV/ 4 2.00 V/
4.50000 V 16.2500 V -1.50000 V 100.000 mV
c1
c2
0.000 s
250.00 ns
500.00 ns
50.0 ns/div
realtime
y2(4) 5.68750 V
y1(4) -125.000 mV
delta y 5.81250 V
x2(4) 441.000 ns
x1(4) 37.000 ns
delta x 404.000 ns
1/delta x 2.47525 MHz


hp
HORIZONTAL
5.00 us/div
100 ns/div
delay
-3.000 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
10 MSa/s
sample clock
c3
c4
c2
c1
-3.000 us
22.000 us
47.000 us
5.00 us/div
realtime
y2(4) -540.000 mV
y1(4) 675.000 mV
delta y -1.21500 V
x2(4) 21.3000 us
x1(4) 24.7080 us
delta x -3.40800 us
1/delta x 293.427 kHz


hp
EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 3
adjust center
level 2.50000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
EDGE,CHAN3 2.50000 V
c2
c1
c3
c4
-250.00 us
250.00 us
750.00 us
100 us/div
realtime
y2(2) 2.50000 V
y1(1) 51.5625 mV
delta y 2.44844 V
x2(2) -183.526 us
x1(1) -183.580 us
delta x 54.000 ns
1/delta x 18.5185 MHz

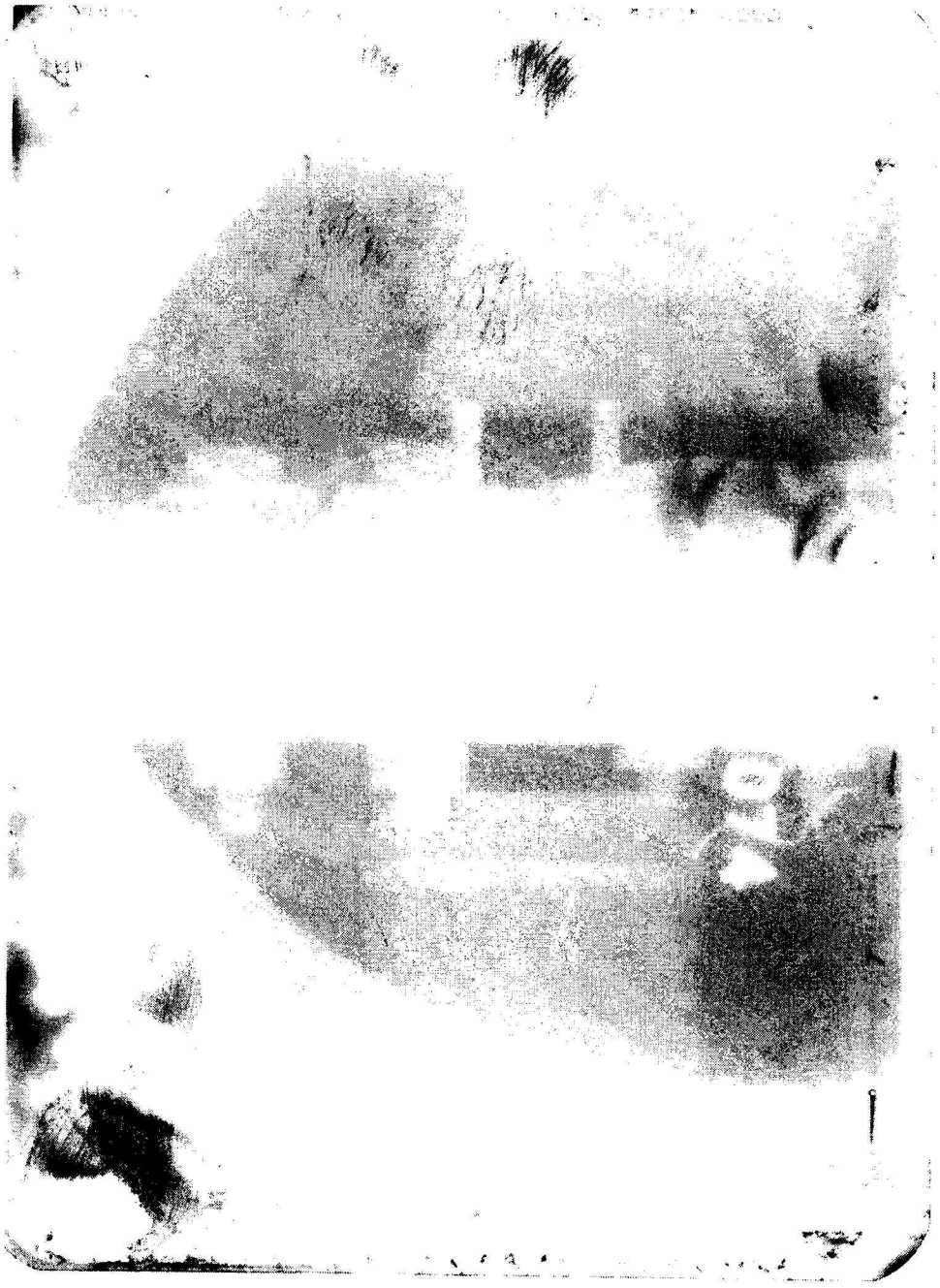
PRINTED : Sep-20-2011:11.27.53
PRODUCT : Classic 6500 S/N 84900024



TRC2M:
(Sep-20-2011:10.41.35)
1V/div,100µs/div
TRC4M:
(Sep-20-2011:10.41.35)
1V/div,100µs/div
TRC3M:
(Sep-20-2011:10.41.35)
500mV/div,100µs/div
TRC1M:
(Sep-20-2011:10.41.35)
50mV/div,100µs/div

TR3M
CURSOR :TRC2 +2.04V
+95.1490µs
CURSOR :TRC1 +55.83mV
+95.1490µs

SHOT 1074



40 mm GUN DATA SHEET

Shot No. 1075 Date 2/2/2012

Target:

Sample Material: Forsterite Single crystal (#15)
Type of Measurement: Pre-heated EOS (2000°C)
Expected Velocity: 2.00 km/sec.

Projectile:

Flyer Material: Mo (#11) Thickness: 0.9981 in. Weight: 20.3593 gms.
Projectile Material: LEXAN Length: 2.5090 in. Dia: 1.5665/1.5615 in.
Weight: 97.4566 gms. Corrected Weight: 93.4566 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle
Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400
Main Charge Weight: 271.024 gms. Powder Type: IMR4350 C/M: 2.90

Laser Distances:

Beam I to Muzzle: 68.40/68.40 cm.
Beam II to Muzzle: 43.20/43.15 cm. 43.175
Beam III to Muzzle: 2.05/2.10 cm.
Beam III to Target: 47.597/47.617 mm.
Co-axial Pin Height: — in.
Shim Thickness: — in.
Total Height: — cm.
Corrected III to Target Distance: — cm.

Estimated Times:

Beam I to II: 126.13 µsec.
Beam II to III: 226.37 µsec.
Beam III to Target: 23.80 µsec.

Actual Beam Distances:

Beam I to II: 0.25235 m.
Beam II to III: 0.45275 m.
Beam III to Target: 0.047617 m.
Fudge: 0.025320

Delays:

Xenon Lamp Delay: -6.127 µsec.
X-ray 1 to 2 Interval: 6.299 µsec.
Lamp Triggered by Laser No.: 3
Camera dial 260 for 2000 ns streak
↳ actual 2033 from cal

Notes:

Temp: 5:42min; sig .115; 7.0 kV; 2001 °C

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: 6.254 µsec.
UDC 224.23 µsec
Counter 6 X-ray interval 6.038 µsec
Tank/Pump Pressure: 110/110 µm.

HP6-1 -24.40 ns*
HP6-2 6.231 µsec
HP6-3 11.561 µsec
HP6-4 OFF µsec

HP5-1 -135.592 µsec
HP5-2 -135.536 µsec
HP5-3 6 ns*
HP5-4 224.006 µsec

GS7-1 -10.086 µsec
GS7-2 1.50 ns*
GS7-3 213.884 µsec
GS7-4 224.006 µsec

Measured Shot Velocities:

Velocity, X-ray:_____m/sec.

Backup Velocity, X-ray : _____ m/s
UDC : 2019.14 m/sec

SETUP: SHOT for scopes

HP6

trig : Ch1 xray 1 50V+ (5V/div)
- second hump (above 30V for 30ns) –lvl 10V+
Ch2 xray2 50V+ -(5V/div)
Ch3 cam monitor -- -1.75V - (500mV/div)
Ch4 photodiode—peak brightness (200mV/div) OFF
TOTAL TIME (from wksht): 122 us
Set time 865 us (100 ns/div)
Delay from trig -20 us (need: 0)

.116 Signal Str.
7 KV

HP5

trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V (2V/div)
Ch1 laser1 analog -- downgoing 150mV (50mV/div)
Ch2 laser 1 TTL, 4V -- level 2.5V+ (2V/ div)
Ch4 laser 3 4V TTL -- jog in sig ~2.5V (2V/div)
TOTAL TIME (from wksht): 362.766 us
Set time 655 us (1µs /div)
Delay from trig -250 us (need: -136)

GS7

trig : Ch2 laser 2 TTL -- 4V+ (1V/div)
Ch1 laser 2 analog -- -150mV (50mV/div)
Ch3 laser 3 analog -- -150mV(50mV/div)
Ch4 laser 3 TTL –4V+ (1V/div)
TOTAL TIME (from wksht): 226 us
Set time 1000 us (M: 100 us)
Pretrigger view 9.8%

40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: ? µsec. Didn't go off SIM 2

UDC 2224 µsec 223.16

Counter 6 X-ray interval ~~2035.37~~ ? µsec Didn't go off.

HP6-1 24.20 ns* -18V SIM 2 24.60 ns

HP6-2 6.46520 µsec 6.396 ~~6.386~~

HP6-3 11.508 µsec 11.572

HP6-4 ? µsec ?

HP5-1 -1.97260 µsec SIM 2 - 2.110

HP5-2 220.3 µsec 223.030

HP5-3 16.00 ns* 10 ns

HP5-4 222.42 µsec 220.904

Measured Shot Velocities:

UDC : 2035.37 m/sec 2028.85

Cal frequency 147.9850 MHz

SETUP: SIM for scopes

HP6

trig : Ch1 xray 1 50V+ (5V/div)

- second hump (above 30V for 30ns) –lvl 10V+

Ch2 xray2 50V+ -(5V/div)

Ch3 cam monitor -- -1.75V - (500mV/div)

Ch4 photodiode—peak brightness—(200mV/div)

TOTAL TIME (from wksht): 122 us

Set time: ~~332~~ 65 us (100 ns/div)

Delay from trig ~20 us (need: 0)

HP5

trig Ch3 laser 2 5V TTL -- jog in sig ~2.5V (2V/div)

Ch1 Mag sim 1 -- zero crossing (6V) (2V/div)

Ch2 Mag sim 2 (2V/div)

Ch4 laser 3 5V TTL -- jog in sig ~2.5V (2V/div)

TOTAL TIME (from wksht): 228.5 us

Set time 655 us (1 µs/div)

Delay from trig ~250 us (need: ~2)

40 mm hot EOS shot Nominal Timeline Preshot 1075

V	2000			Laser1-Laser2 distance	0.25225
cable time	75	ch1	ch2	Laser2-Laser3 distance	0.45275
photodiode intrinsic delays	[redacted]			Laser3-target distance	0.047617
UDC extra count lag	118	2140	2140	Laser3-target fudge	0.025320
pulse translator delay	150			Laser3-Xray2 % of Laser3-target	75
X-ray 1 program delay	0	971	X-ray 1 delay amp intrinsic		
X-ray 2 program delay	6299.4	1216	X-ray 2 delay amp intrinsic		
X-ray 1 pulser delay	426			Us(Mo)	6183.01722
X-ray 2 pulser delay	887			driver thickness	0.00103886
Lamp trigger to peak bright	[redacted]			sample thickness	0.00254
HV3 program delay	-5127			cap thickness	0.00078003
Camera intrinsic delay	107			estimated sample+cover time	539.960666
Streak duration	2000				
d dead streak before driver	750				

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-126125	-0.25225		Laser 1 actual interrupt		HP5-1
-125925	-0.25185		Laser 1 TTL out		
-125850	-0.2517		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
10178	0.020356		Laser 2 TTL out (shot)		GS7-2 & Trig
8113	0.016226		Magnet Sim 1 analog (sim)	HP5-1	
10253	0.020506		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
226375	0.45275		Laser 3 actual interrupt		GS7-3
236566	0.473132		Laser 3 TTL out		GS7-4
234501	0.469002		Magnet Sim 2 analog (sim)	HP5-2	
236641	0.473282		Laser 3 TTL at UDC (start down-count) and pulse translat	HP5-4, UDC stop	HP5-4, UDC stop
236866	0.473732		Pulse translator out reaches X-ray delay amps 1 & 2		
237837	0.475674		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
238263	0.476526		X-ray 1 fires		
238338	0.476676		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
244381	0.48876275		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
245268	0.48846275		X-ray 2 fires		
245343	0.49068675		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
243293	0.48658504		HV3 out to lamp		
249420	0.49883904		UDC zero time, HV1 out to camera		
249495	0.49898904		Trigger at camera		
249602	0.49920304		Begin Streak		
249677	0.49935304		Camera Monitor reaches control lab	HP6-3	HP6-3
250570	0.50113904		Lamp Peak Bright	HP6-4	HP6-4
250184	0.500367	0	IMPACT		
250352		0.00103886	Driver arrival on streak	Driver cutoff on streak	750
250891		0.004377446	Sample cutoff on streak	Sample cutoff on sreak	1290
251602		0.008767632	End Streak		

	rho0	Co	s			
Cold Mo	10206	5033	1.28946405			
Hot Mo	9785	4857.9	1.2875	2273		
Liquid Forsterite	[redacted]					

				up	P	Us
driver	562.0825943	-151542430	1.55375E+11	1029.21726	62.2684915	6183.01722
sample	8799.754822	-109409032	1.51227E+11	1584.02914	25.3860003	6039.37844
cap	-8799.75482	-81611256	69833662597	788.626671	45.3222314	5873.25684

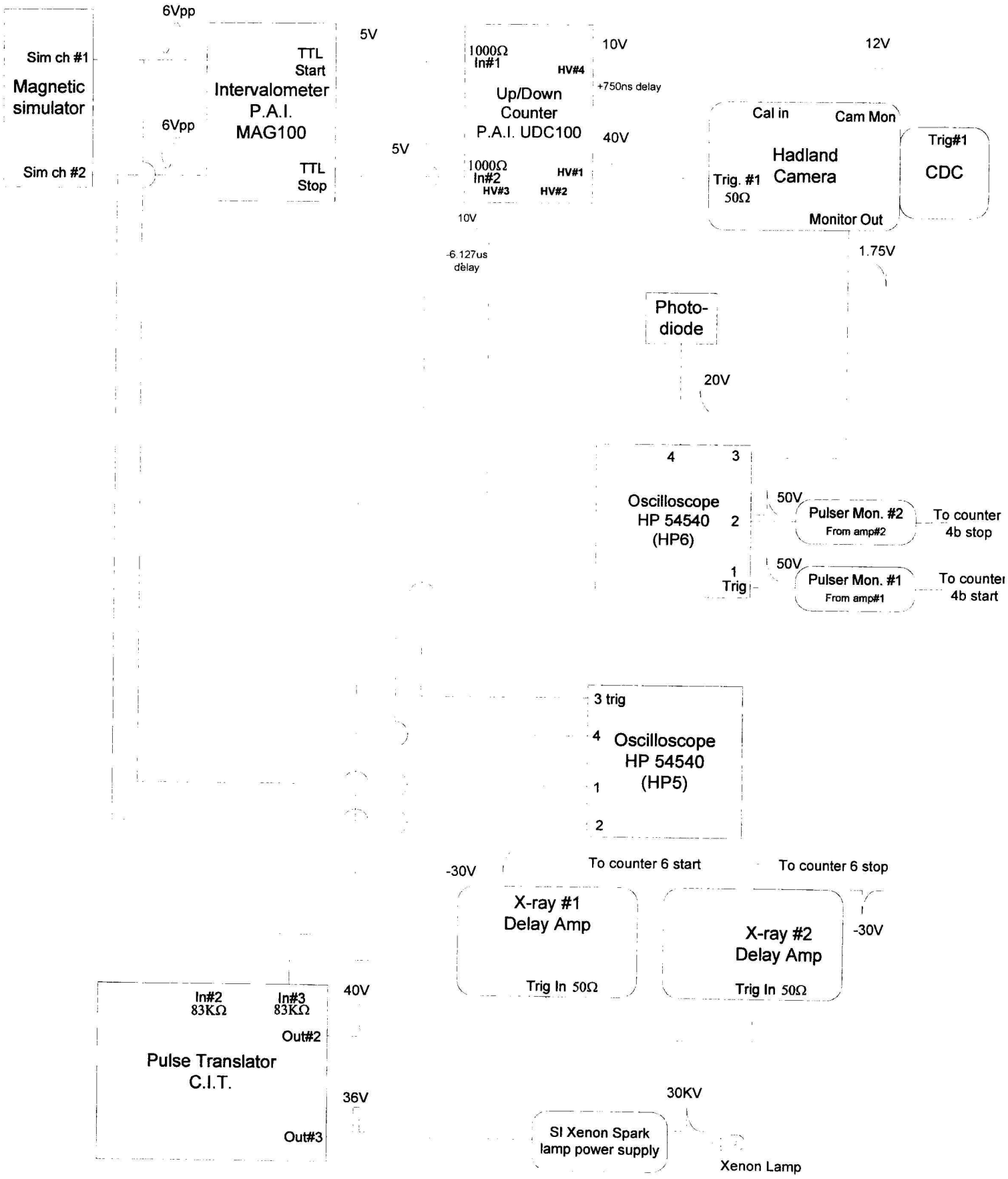
Cold Mo	10206	5033	1.28946405	300	
Hot Mo	9961.5	4927.8728	1.288702471	1300	
	9937	4918.5831	1.28837124	1407	
	9913	4908.7717	1.2882417	1508	
	9875	4893.13	1.28807834	1659	
			1.2881	1873	
2273K	10278.85	5063.57067			

			-0.2432346	10278.8461
			0.00084228	1.11652606
			0.99996403	0.9080814

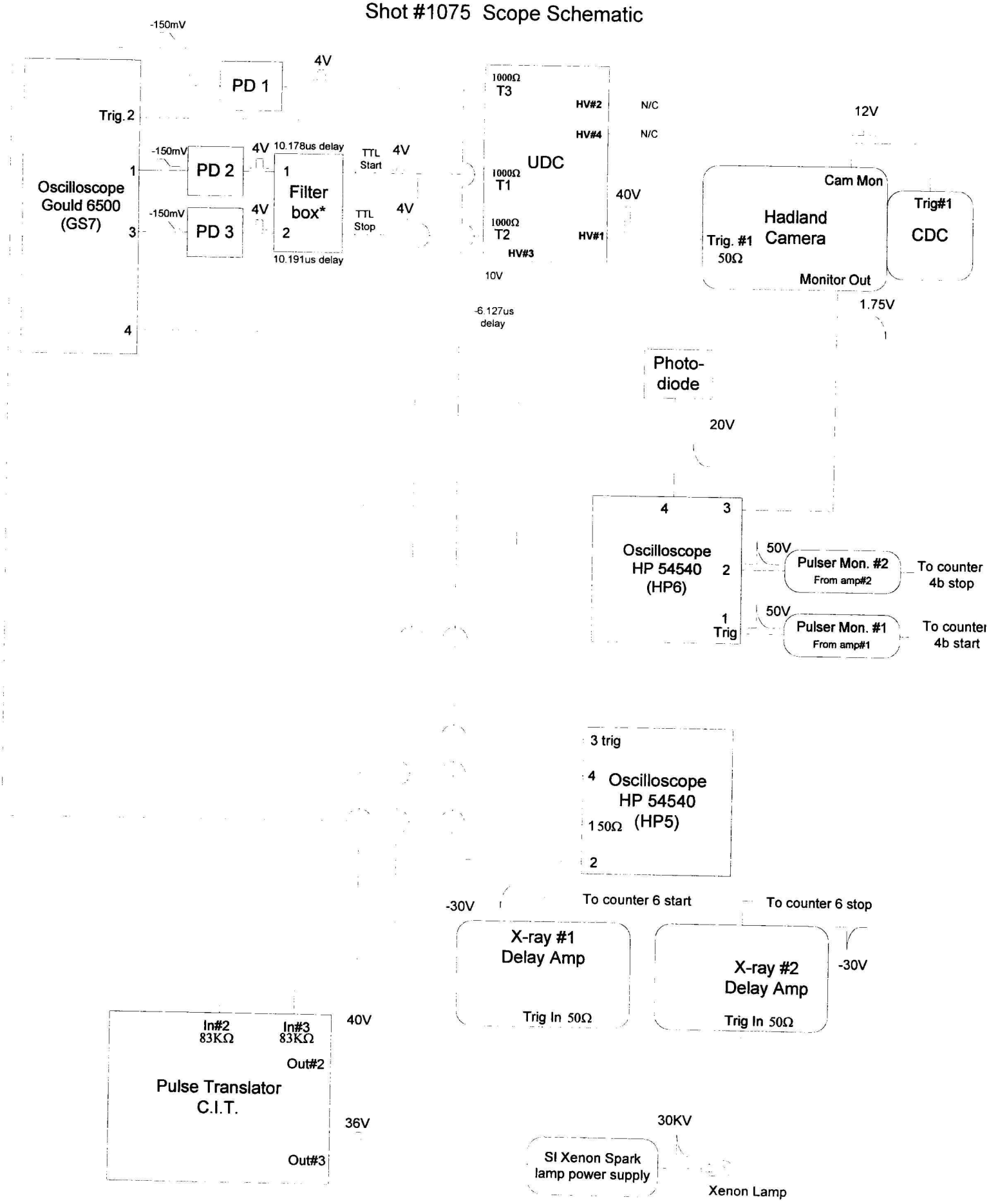
	SIM	SHOT			
HP6 1	0	0		-0.1030929	5063.57067
HP6 2	7005	7005		0.001035	1.37199182
HP6 3	11339	11339		0.99969772	1.11585417
HP6 4	12232	12232			
UDC upcount:	226388	226388			
HP5 1	-2140	-136378			
HP5 2	224248	-136103			
HP5 3	0	0			
HP5 4	226388	226388	362766	228528	
GS7 1		-275			
GS7 2		0			
GS7 3		216197			
GS7 4		226388		226663	
Counter 4b:	7005	7005			
Counter 6:	6544	6544			

Shot #1075 Scope Schematic for SIM

Live camera
Live lamp
Live x-ray



Shot #1075 Scope Schematic

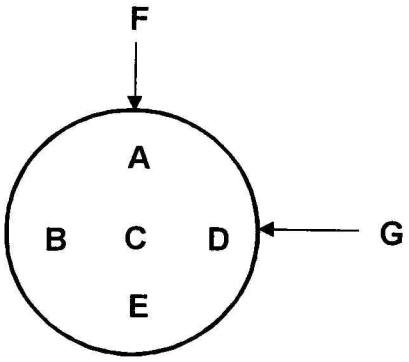


* new circuit locks out TTL pulses shorter than an adjustable threshold (nominally 10 microseconds)

SHOT No.

FLYER PLATE MATERIAL: **Mo #11** 12/21/2011

Measurement done by: Russ



DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.09975	F	1.24900
A	0.09975	F	1.24950
B	0.09995	G	1.24950
B	0.09990	G	1.24950
C	0.09990		
C	0.09980		
D	0.09970		
D	0.09970		
E	0.09985		
E	0.09975		

Statistic for thickness

N	10
MAX	0.09995
MIN	0.09970
Range	0.00025
MEAN	0.099814286
	2.535282857
STDEV	0.000102933

Statistic for Diameter (F-G)

N	4
MAX	1.24950
MIN	1.24900
Range	0.00050
MEAN	1.2493750 inch
	31.7341250 mm
STDEV	0.00025

	Sample in Air	Crystal Density	
1	20.35943	10.216	
2	20.35932	10.217	
3	20.35917	10.219	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.099814286	±	in
FLATNESS:	0.00025	in.	
VOLUME:	2.0053	9.35E-04	cm^3
CRYSTAL DENSITY:	10.2173	#DIV/0!	$grams/cm^3$
BULK DENSITY:	10.1530	#DIV/0!	$grams/cm^3$
DENSITIES CHECKED BY: _____		on _____	
MEASUREMENT CHECKED E	Russ	12/21/2011	

SHOT No. ___1075_____

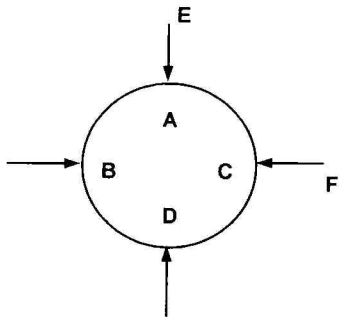
LGG Moly Capsule Cap

SAMPLE MATERIAL: Mo 15

11/18/2010

Post polish

Thickness Measurement	
A	0.03075
A	0.03075
B	0.03075
B	0.03075
C	0.03070
C	0.03065
D	0.03070
D	0.03065



Diameter Measurement	
E	0.35350
E	0.35400
F	0.35350
F	0.35450
AVE	0.35388
Radius	0.1769

Statistic for thickness	
N	8
MAX	0.03075
MIN	0.0307
Range	1E-04
MEAN	0.03071
STDEV	4.43203E-05

Statistic for perimeter	
N	4
MAX	0.35450
MIN	0.3535
Range	0.001
MEAN	0.353875
STDEV	0.000478714

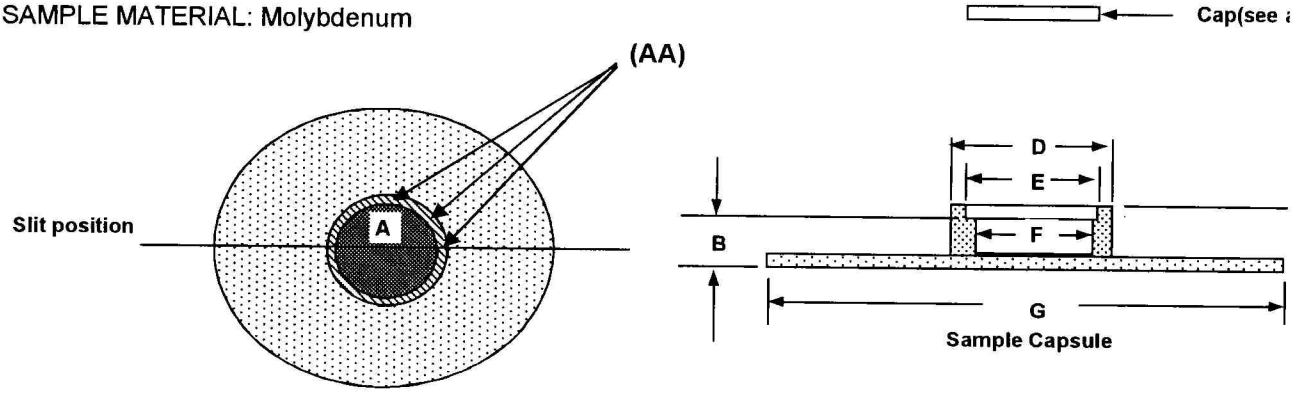
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.0307125	±	mm	
	FLATNESS:		1E-04			
	VOLUME:		0.0495		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.0457		$grams/cm^3$	

SHOT No.: 1075 post polish

SAMPLE CAPSULE: 15

SAMPLE MATERIAL: Molybdenum



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04150
A	0.04150
A	0.04165
A	0.04130
Avg	0.04149

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17170
C	0.17175
C	0.17140
C	0.17175
D	0.3965
D	0.3965

Measurement for (B) is intervals starting at the clockwise around the e the inner lip. (see exam

B point 1(top)
B point 2
B point 3
B point 4
B point 5
B point 6
B point 7
B point 8

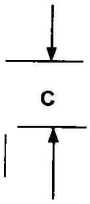
DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3490
E	0.3520
F	0.3140
F	0.3140
G	1.7475
G	1.7480
H	0.10069

Statistics	
N	
MAX	
MIN	
Range	
Average	

MEASUREMENT BY:			Claire		
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene
1	21.8	1.88200	10.65532	11.63431	0.8640
2	21.8	1.88204	10.65544	11.63430	0.8640
3	21.8	1.88200	10.65536	11.63438	0.8640
	THICKNESS:			±	mm
	FLATNESS:			mm	
	VOLUME:				cm³
	CRYSTAL DENSITY:		10.1943	1.17E-03	grams/cm³
	BULK DENSITY:				grams/cm³

attached sheet)



taken at 45 degree
top and moving
entire circumference of
ple AA)

0.14220
0.14220
0.14220
0.14215
0.14220
0.14220
0.14215
0.14215

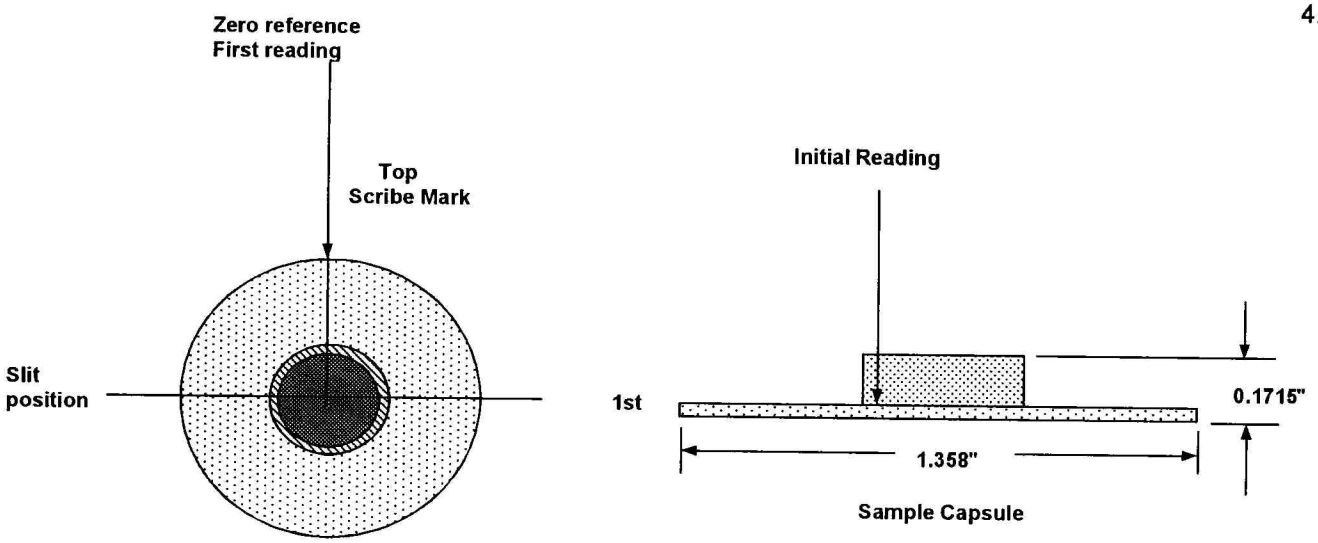
	8
	0.14220
	0.14215
	0.00005
0.14218	

Crystal Density
10.1948
10.1930
10.1952

SAMPLE CAPSULE **15**
SAMPLE MATERIAL **Molybdenum**

INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

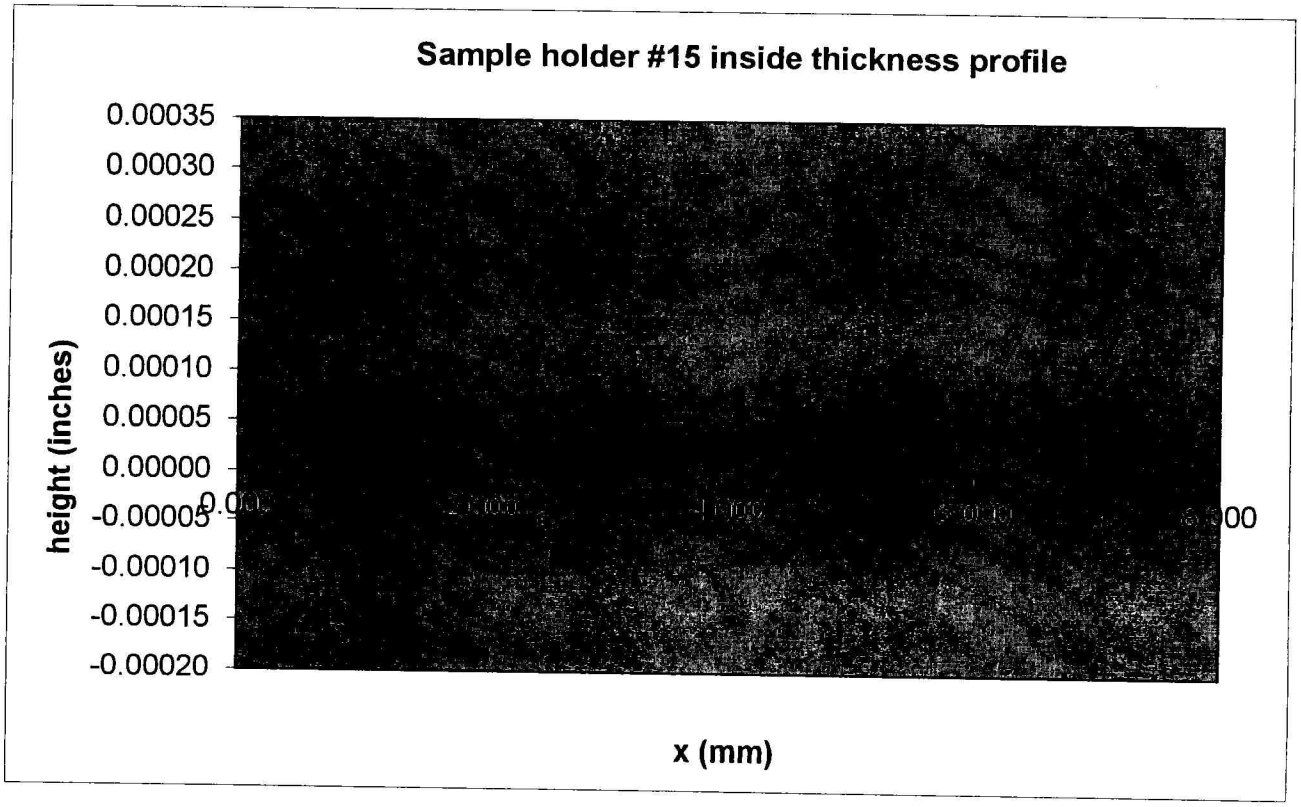
4.7475
4.623



1.338582677

Average thickness reading = 0.00000

Note: The thickness of the reference zero point from the base is = **0.04525** Inches
1.14935 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

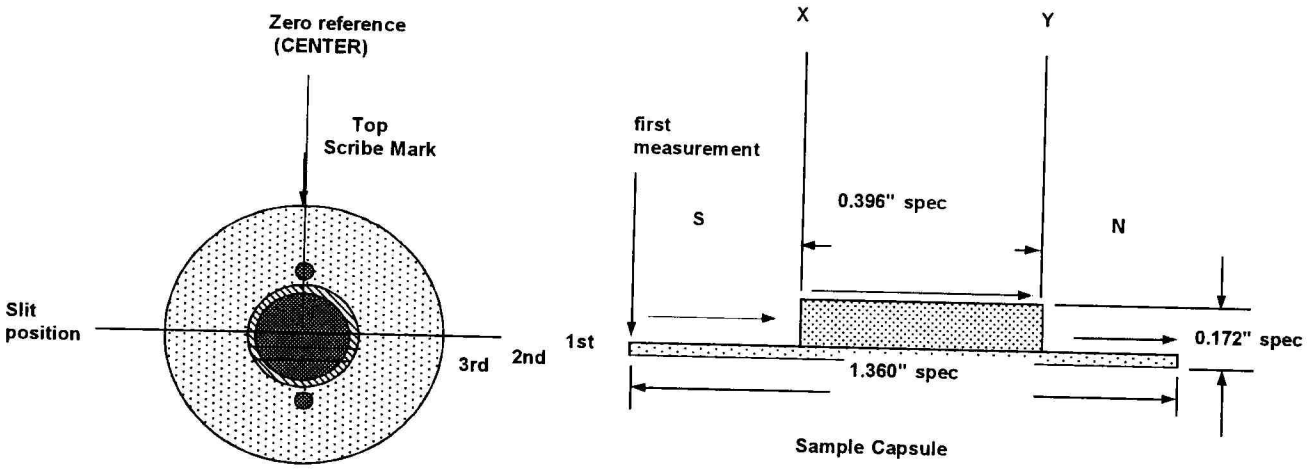
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00005	3.6	south
2	0.200	0.00010	3.40	
3	0.400	0.00000	3.20	
4	0.600	0.00000	3.00	
5	0.800	-0.00005	2.80	
6	1.000	-0.00010	2.60	
7	1.200	-0.00010	2.40	
8	1.400	-0.00010	2.20	
9	1.600	-0.00010	2.00	
10	1.800	-0.00015	1.80	
11	2.000	-0.00010	1.60	
12	2.200	-0.00010	1.40	
13	2.400	-0.00010	1.20	
14	2.600	-0.00010	1.00	
15	2.800	-0.00010	0.80	
16	3.000	-0.00005	0.60	
17	3.200	0.00000	0.40	
18	3.400	0.00005	0.20	
19	3.600	0.00005	0.00	
20	3.800	0.00000	-0.20	
21	4.000	-0.00005	-0.40	
22	4.200	-0.00005	-0.60	
23	4.400	0.00000	-0.80	
24	4.600	-0.00005	-1.00	
25	4.800	0.00000	-1.20	
26	5.000	0.00000	-1.40	
27	5.200	0.00000	-1.60	
28	5.400	0.00000	-1.80	
29	5.600	0.00000	-2.00	
30	5.800	0.00000	-2.20	
31	6.000	0.00000	-2.40	
32	6.200	0.00010	-2.60	
33	6.400	0.00015	-2.80	
34	6.600	0.00020	-3.00	
35	6.800	0.00020	-3.20	
36	7.000	0.00030	-3.40	
37	7.200	0.00020	-3.60	north

SHOT No. 1075
SAMPLE CAPSULE: 15
SAMPLE MATERIAL:

tip used: .7mm long/ flat tip
note: the platform on which the measurement was taken deviates from flat by +0.013 max.
direction of measurement

2.3575 4.715

THICKNESS PROFILE (Not re-polished, but final surface)



First Run Horizontal (X) thru the center with 0.100 MM increment
1st Reading
Average thickness reading = -0.00003

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment
2nd Reading
Average thickness reading = 0.00000

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment
3rd Reading
Average thickness reading = 0.00001

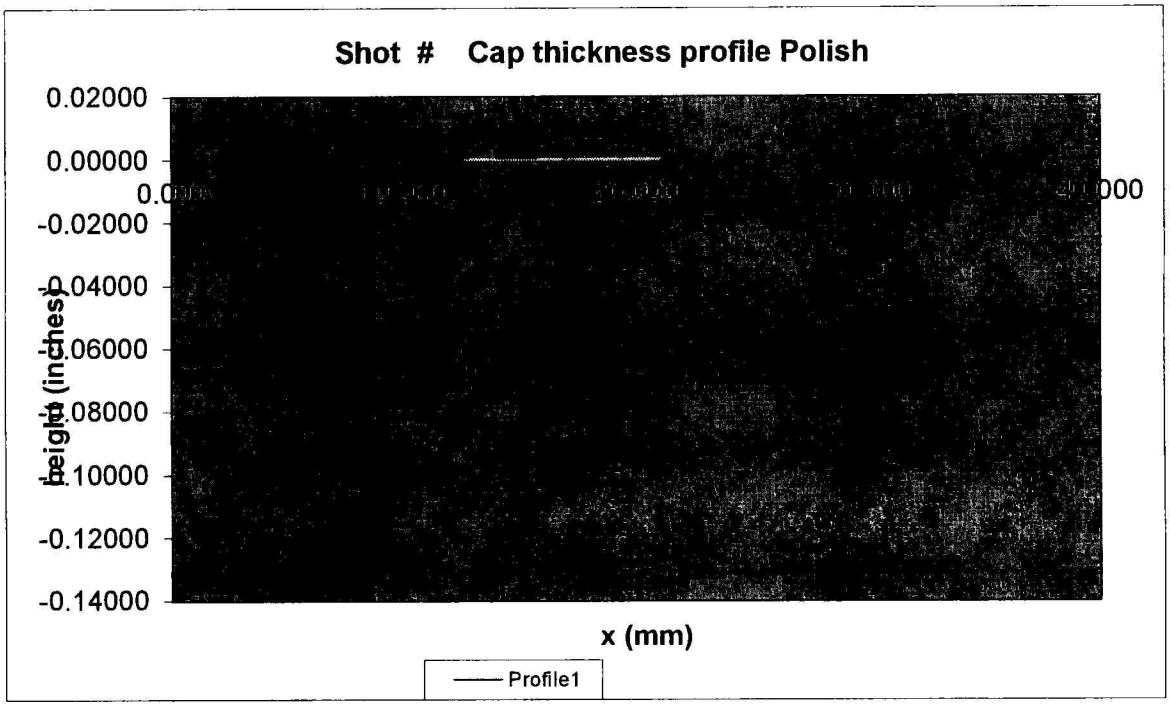
Note: Measurement from reference zero point from the base is = **0.1722** Inches
4.3739 mm

Average thickness of the driver Plate = 0.0409 Inches
1.0396 mm

Thickness of the Carbon Deposited on the coil side is = **nm**

Thickness of the C Deposited on the Projectile side is = **nm**

Unsupported Personality: PCL



Unsupported Personality: PCL

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Bel

3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

Number 3 Reading	Reading Distance mm	abs dist. mm	South (left side)	Number of Reading	Reading Distance mm	abs dist. mm	North(right
1	0.000	17.000	-0.1315	225	22.400	-5.400	-0.1291
2	0.100	16.900	-0.1315	226	22.500	-5.500	-0.1295
3	0.200	16.800	-0.1315	227	22.600	-5.600	-0.1310
4	0.300	16.700	-0.1315	228	22.700	-5.700	-0.1310
5	0.400	16.600	-0.1315	229	22.800	-5.800	-0.1310
6	0.500	16.500	-0.1315	230	22.900	-5.900	-0.1310
7	0.600	16.400	-0.1315	231	23.000	-6.000	-0.1310
8	0.700	16.300	-0.1315	232	23.100	-6.100	-0.1310
9	0.800	16.200	-0.1315	233	23.200	-6.200	-0.1310
10	0.900	16.100	-0.1315	234	23.300	-6.300	-0.1310
11	1.000	16.000	-0.1315	235	23.400	-6.400	-0.1310
12	1.100	15.900	-0.1315	236	23.500	-6.500	-0.1310
13	1.200	15.800	-0.1315	237	23.600	-6.600	-0.1311
14	1.300	15.700	-0.1315	238	23.700	-6.700	-0.1311
15	1.400	15.600	-0.1315	239	23.800	-6.800	-0.1311
16	1.500	15.500	-0.1315	240	23.900	-6.900	-0.1311
17	1.600	15.400	-0.1315	241	24.000	-7.000	-0.1311
18	1.700	15.300	-0.1316	242	24.100	-7.100	-0.1311
19	1.800	15.200	-0.1315	243	24.200	-7.200	-0.1311
20	1.900	15.100	-0.1316	244	24.300	-7.300	-0.1311
21	2.000	15.000	-0.1316	245	24.400	-7.400	-0.1311
22	2.100	14.900	-0.1316	246	24.500	-7.500	-0.1311
23	2.200	14.800	-0.1316	247	24.600	-7.600	-0.1311
24	2.300	14.700	-0.1316	248	24.700	-7.700	-0.1311
25	2.400	14.600	-0.1316	249	24.800	-7.800	-0.1311
26	2.500	14.500	-0.1316	250	24.900	-7.900	-0.1311
27	2.600	14.400	-0.1316	251	25.000	-8.000	-0.1311
28	2.700	14.300	-0.1316	252	25.100	-8.100	-0.1311
29	2.800	14.200	-0.1316	253	25.200	-8.200	-0.1311
30	2.900	14.100	-0.1316	254	25.300	-8.300	-0.1311
31	3.000	14.000	-0.1316	255	25.400	-8.400	-0.1311
32	3.100	13.900	-0.1316	256	25.500	-8.500	-0.1311
33	3.200	13.800	-0.1316	257	25.600	-8.600	-0.1311
34	3.300	13.700	-0.1316	258	25.700	-8.700	-0.1312
35	3.400	13.600	-0.1316	259	25.800	-8.800	-0.1312
36	3.500	13.500	-0.1316	260	25.900	-8.900	-0.1311
37	3.600	13.400	-0.1316	261	26.000	-9.000	-0.1312
38	3.700	13.300	-0.1316	262	26.100	-9.100	-0.1312
39	3.800	13.200	-0.1316	263	26.200	-9.200	-0.1312
40	3.900	13.100	-0.1316	264	26.300	-9.300	-0.1311
41	4.000	13.000	-0.1316	265	26.400	-9.400	-0.1311
42	4.100	12.900	-0.1316	266	26.500	-9.500	-0.1312
43	4.200	12.800	-0.1316	267	26.600	-9.600	-0.1312
44	4.300	12.700	-0.1316	268	26.700	-9.700	-0.1311
45	4.400	12.600	-0.1316	269	26.800	-9.800	-0.1312
46	4.500	12.500	-0.1316	270	26.900	-9.900	-0.1312
47	4.600	12.400	-0.1316	271	27.000	-10.000	-0.1311
48	4.700	12.300	-0.1316	272	27.100	-10.100	-0.1312
49	4.800	12.200	-0.1316	273	27.200	-10.200	-0.1312
50	4.900	12.100	-0.1316	274	27.300	-10.300	-0.1312
51	5.000	12.000	-0.1316	275	27.400	-10.400	-0.1312
52	5.100	11.900	-0.1316	276	27.500	-10.500	-0.1312
53	5.200	11.800	-0.1316	277	27.600	-10.600	-0.1312

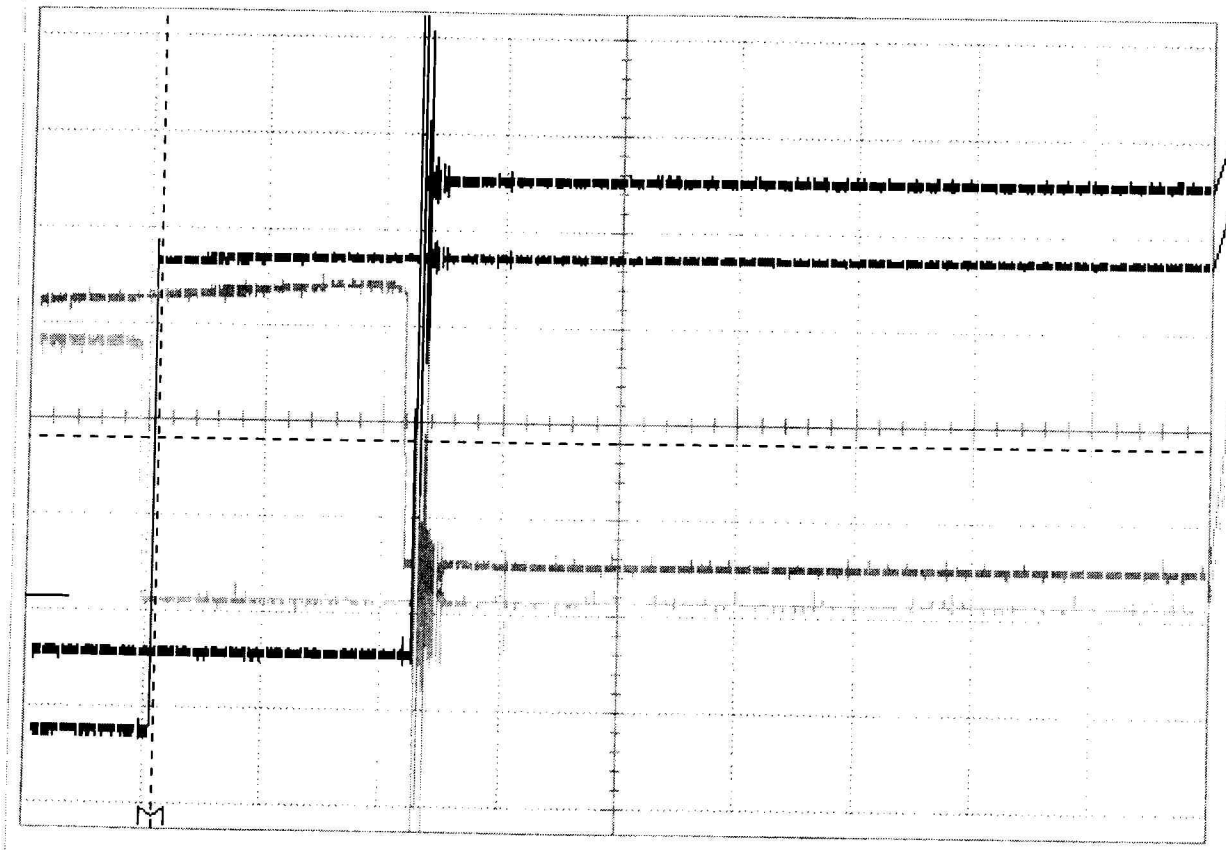
54	5.300	11.700	-0.1316	278	27.700	-10.700	-0.1312
55	5.400	11.600	-0.1316	279	27.800	-10.800	-0.1312
56	5.500	11.500	-0.1316	280	27.900	-10.900	-0.1312
57	5.600	11.400	-0.1316	281	28.000	-11.000	-0.1312
58	5.700	11.300	-0.1316	282	28.100	-11.100	-0.1312
59	5.800	11.200	-0.1316	283	28.200	-11.200	-0.1312
60	5.900	11.100	-0.1316	284	28.300	-11.300	-0.1312
61	6.000	11.000	-0.1316	285	28.400	-11.400	-0.1312
62	6.100	10.900	-0.1316	286	28.500	-11.500	-0.1312
63	6.200	10.800	-0.1316	287	28.600	-11.600	-0.1312
64	6.300	10.700	-0.1316	288	28.700	-11.700	-0.1312
65	6.400	10.600	-0.1316	289	28.800	-11.800	-0.1312
66	6.500	10.500	-0.1315	290	28.900	-11.900	-0.1312
67	6.600	10.400	-0.1315	291	29.000	-12.000	-0.1312
68	6.700	10.300	-0.1315	292	29.100	-12.100	-0.1312
69	6.800	10.200	-0.1315	293	29.200	-12.200	-0.1312
70	6.900	10.100	-0.1315	294	29.300	-12.300	-0.1312
71	7.000	10.000	-0.1315	295	29.400	-12.400	-0.1312
72	7.100	9.900	-0.1315	296	29.500	-12.500	-0.1312
73	7.200	9.800	-0.1315	297	29.600	-12.600	-0.1312
74	7.300	9.700	-0.1315	298	29.700	-12.700	-0.1312
75	7.400	9.600	-0.1315	299	29.800	-12.800	-0.1312
76	7.500	9.500	-0.1315	300	29.900	-12.900	-0.1312
77	7.600	9.400	-0.1315	301	30.000	-13.000	-0.1312
78	7.700	9.300	-0.1315	302	30.100	-13.100	-0.1312
79	7.800	9.200	-0.1315	303	30.200	-13.200	-0.1312
80	7.900	9.100	-0.1315	304	30.300	-13.300	-0.1312
81	8.000	9.000	-0.1315	305	30.400	-13.400	-0.1312
82	8.100	8.900	-0.1315	306	30.500	-13.500	-0.1312
83	8.200	8.800	-0.1315	307	30.600	-13.600	-0.1312
84	8.300	8.700	-0.1314	308	30.700	-13.700	-0.1312
85	8.400	8.600	-0.1314	309	30.800	-13.800	-0.1312
86	8.500	8.500	-0.1314	310	30.900	-13.900	-0.1312
87	8.600	8.400	-0.1314	311	31.000	-14.000	-0.1312
88	8.700	8.300	-0.1314	312	31.100	-14.100	-0.1312
89	8.800	8.200	-0.1314	313	31.200	-14.200	-0.1311
90	8.900	8.100	-0.1314	314	31.300	-14.300	-0.1311
91	9.000	8.000	-0.1314	315	31.400	-14.400	-0.1311
92	9.100	7.900	-0.1314	316	31.500	-14.500	-0.1311
93	9.200	7.800	-0.1314	317	31.600	-14.600	-0.1311
94	9.300	7.700	-0.1314	318	31.700	-14.700	-0.1312
95	9.400	7.600	-0.1314	319	31.800	-14.800	-0.1311
96	9.500	7.500	-0.1314	320	31.900	-14.900	-0.1311
97	9.600	7.400	-0.1314	321	32.000	-15.000	-0.1311
98	9.700	7.300	-0.1314	322	32.100	-15.100	-0.1311
99	9.800	7.200	-0.1314	323	32.200	-15.200	-0.1311
100	9.900	7.100	-0.1314	324	32.300	-15.300	-0.1311
101	10.000	7.000	-0.1314	325	32.400	-15.400	-0.1312
102	10.100	6.900	-0.1314	326	32.500	-15.500	-0.1311
103	10.200	6.800	-0.1314	327	32.600	-15.600	-0.1311
104	10.300	6.700	-0.1314	328	32.700	-15.700	-0.1311
105	10.400	6.600	-0.1313	329	32.800	-15.800	-0.1311
106	10.500	6.500	-0.1313	330	32.900	-15.900	-0.1311
107	10.600	6.400	-0.1313	331	33.000	-16.000	-0.1311
108	10.700	6.300	-0.1313	332	33.100	-16.100	-0.1311
109	10.800	6.200	-0.1313	333	33.200	-16.200	-0.1311
110	10.900	6.100	-0.1313	334	33.300	-16.300	-0.1311
111	11.000	6.000	-0.1313	335	33.400	-16.400	-0.1311
112	11.100	5.900	-0.1313	336	33.500	-16.500	-0.1311
113	11.200	5.800	-0.1313	337	33.600	-16.600	-0.1311
114	11.300	5.700	-0.1313	338	33.700	-16.700	-0.1311
115	11.400	5.600	-0.1313	339	33.800	-16.800	-0.1310
116	11.500	5.500	-0.1311	340	33.900	-16.900	-0.1310
117	11.600	5.400	-0.1309	341	34.000	-17.000	-0.1310

ɔw the center with 0.100 MM increment

Number of Reading	Reading Distance mm	abs dist. mm	1st Run Reading Inches	2nd Run Reading Inches	3 rd Run Reading Inches
118	11.700	5.300			
119	11.800	5.200			
120	11.900	5.100			
121	12.000	5.000			
122	12.100	4.900			
123	12.200	4.800			
124	12.300	4.700	-0.00070		
125	12.400	4.600	-0.00070		
126	12.500	4.500	-0.00070	-0.00070	
127	12.600	4.400	-0.00030	-0.00030	
128	12.700	4.300	-0.00005	-0.00005	
129	12.800	4.200	0.00005	0.00005	
130	12.900	4.100	0.00000	0.00000	0.00000
131	13.000	4.000	-0.00005	-0.00005	-0.00005
132	13.100	3.900	0.00000	0.00000	0.00000
133	13.200	3.800	0.00000	0.00000	0.00000
134	13.300	3.700	0.00000	0.00000	0.00000
135	13.400	3.600	0.00000	0.00000	0.00000
136	13.500	3.500	0.00000	0.00000	0.00000
137	13.600	3.400	0.00000	0.00000	0.00000
138	13.700	3.300	0.00000	0.00000	0.00000
139	13.800	3.200	0.00000	0.00000	0.00000
140	13.900	3.100	0.00000	0.00000	0.00000
141	14.000	3.000	0.00000	0.00000	0.00000
142	14.100	2.900	0.00000	0.00000	0.00000
143	14.200	2.800	0.00000	0.00000	0.00000
144	14.300	2.700	-0.00005	-0.00005	-0.00005
145	14.400	2.600	-0.00005	-0.00005	-0.00005
146	14.500	2.500	0.00000	0.00000	0.00000
147	14.600	2.400	-0.00005	-0.00005	-0.00005
148	14.700	2.300	-0.00005	-0.00005	-0.00005
149	14.800	2.200	-0.00005	-0.00005	-0.00005
150	14.900	2.100	-0.00005	-0.00005	-0.00005
151	15.000	2.000	0.00000	0.00000	0.00000
152	15.100	1.900	-0.00005	-0.00005	-0.00005
153	15.200	1.800	-0.00005	-0.00005	-0.00005
154	15.300	1.700	0.00000	0.00000	0.00000
155	15.400	1.600	-0.00005	-0.00005	-0.00005
156	15.500	1.500	-0.00005	-0.00005	-0.00005
157	15.600	1.400	-0.00005	-0.00005	-0.00005
158	15.700	1.300	-0.00005	-0.00005	-0.00005
159	15.800	1.200	-0.00005	-0.00005	-0.00005
160	15.900	1.100	-0.00005	-0.00005	-0.00005
161	16.000	1.000	0.00000	0.00000	0.00000
162	16.100	0.900	0.00000	0.00000	0.00000
163	16.200	0.800	0.00000	0.00000	0.00000
164	16.300	0.700	0.00000	0.00000	0.00000
165	16.400	0.600	0.00000	0.00000	0.00000
166	16.500	0.500	0.00000	0.00000	0.00000
167	16.600	0.400	0.00000	0.00000	0.00000
168	16.700	0.300	0.00000	0.00000	0.00000
169	16.800	0.200	0.00000	0.00000	0.00000
170	16.900	0.100	0.00000	0.00000	0.00000

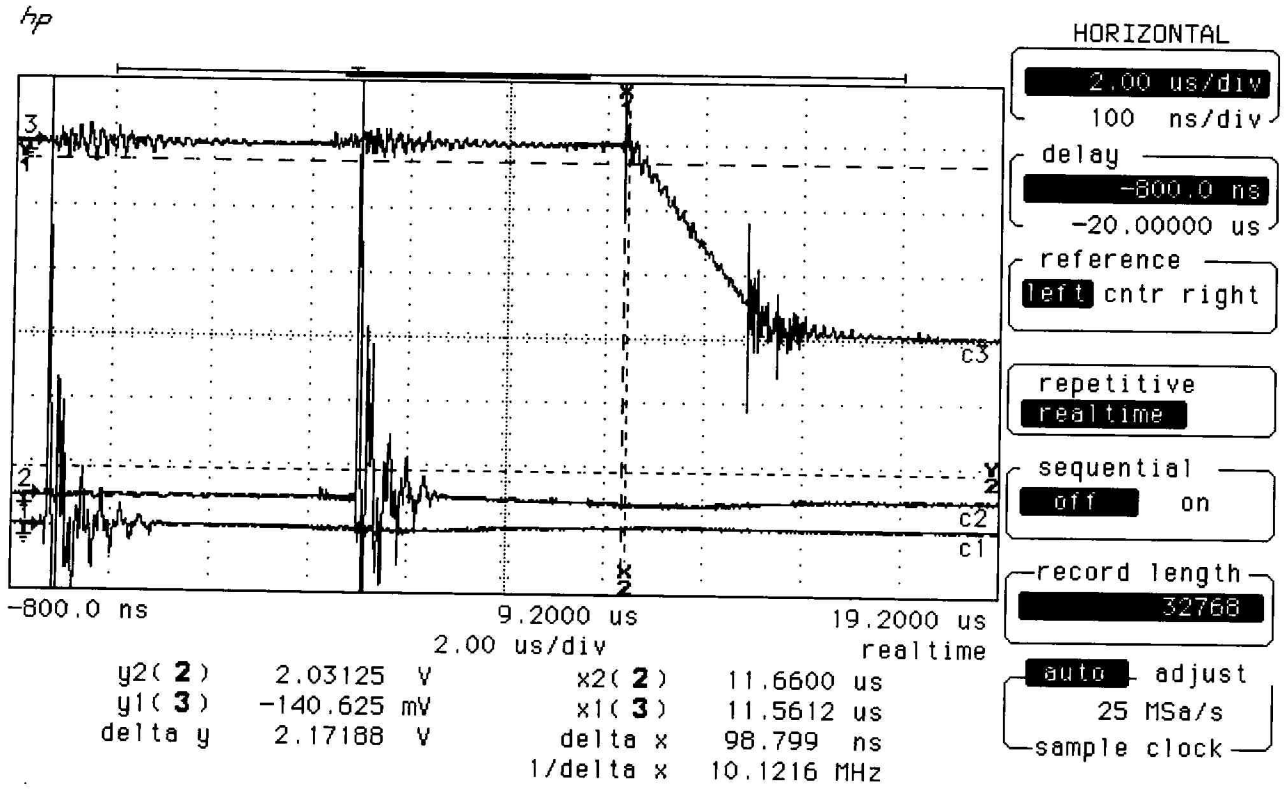
171	17.000	0.000	0.00000	0.00000	0.00000
172	17.100	-0.100	0.00000	0.00000	0.00000
173	17.200	-0.200	-0.00005	-0.00005	-0.00005
174	17.300	-0.300	-0.00005	-0.00005	-0.00005
175	17.400	-0.400	0.00000	0.00000	0.00000
176	17.500	-0.500	0.00000	0.00000	0.00000
177	17.600	-0.600	0.00000	0.00000	0.00000
178	17.700	-0.700	0.00000	0.00000	0.00000
179	17.800	-0.800	0.00000	0.00000	0.00000
180	17.900	-0.900	0.00000	0.00000	0.00000
181	18.000	-1.000	0.00000	0.00000	0.00000
182	18.100	-1.100	0.00000	0.00000	0.00000
183	18.200	-1.200	0.00000	0.00000	0.00000
184	18.300	-1.300	0.00000	0.00000	0.00000
185	18.400	-1.400	0.00005	0.00005	0.00005
186	18.500	-1.500	0.00005	0.00005	0.00005
187	18.600	-1.600	0.00005	0.00005	0.00005
188	18.700	-1.700	0.00005	0.00005	0.00005
189	18.800	-1.800	0.00005	0.00005	0.00005
190	18.900	-1.900	0.00005	0.00005	0.00005
191	19.000	-2.000	0.00005	0.00005	0.00005
192	19.100	-2.100	0.00000	0.00000	0.00000
193	19.200	-2.200	0.00005	0.00005	0.00005
194	19.300	-2.300	0.00005	0.00005	0.00005
195	19.400	-2.400	0.00005	0.00005	0.00005
196	19.500	-2.500	0.00005	0.00005	0.00005
197	19.600	-2.600	0.00005	0.00005	0.00005
198	19.700	-2.700	0.00005	0.00005	0.00005
199	19.800	-2.800	0.00005	0.00005	0.00005
200	19.900	-2.900	0.00005	0.00005	0.00005
201	20.000	-3.000	0.00005	0.00005	0.00005
202	20.100	-3.100	0.00010	0.00010	0.00010
203	20.200	-3.200	0.00005	0.00005	0.00005
204	20.300	-3.300	0.00005	0.00005	0.00005
205	20.400	-3.400	0.00005	0.00005	0.00005
206	20.500	-3.500	0.00010	0.00010	0.00010
207	20.600	-3.600	0.00010	0.00010	0.00010
208	20.700	-3.700	0.00005	0.00005	0.00005
209	20.800	-3.800	0.00005	0.00005	0.00005
210	20.900	-3.900	0.00005	0.00005	0.00005
211	21.000	-4.000	0.00005	0.00005	0.00005
212	21.100	-4.100	0.00005	0.00005	0.00005
213	21.200	-4.200	0.00005	0.00005	0.00005
214	21.300	-4.300	0.00005	0.00005	0.00005
215	21.400	-4.400	0.00000	0.00000	
216	21.500	-4.500	0.00005	0.00005	
217	21.600	-4.600	-0.00005	-0.00005	
218	21.700	-4.700	-0.00070		
219	21.800	-4.800	-0.00070		
220	21.900	-4.900			
221	22.000	-5.000			
222	22.100	-5.100			
223	22.200	-5.200			
224	22.300	-5.300			

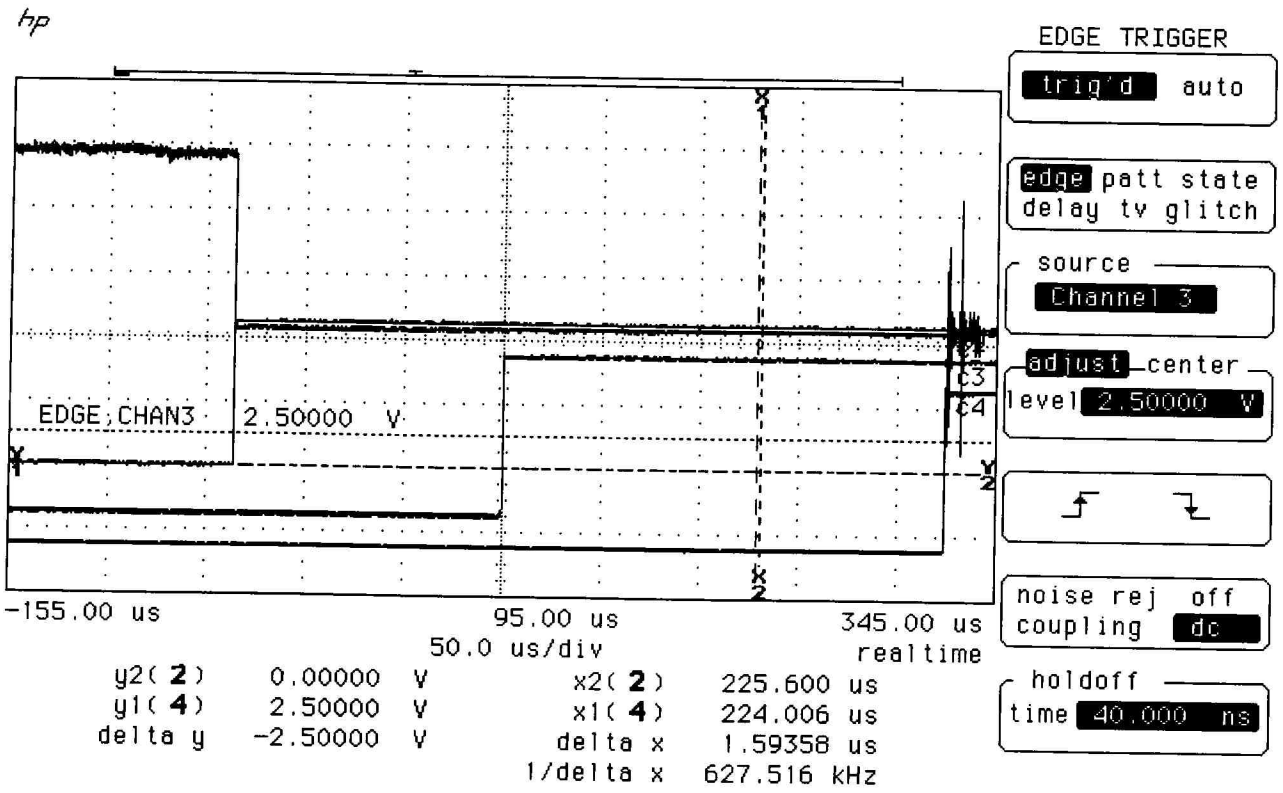
PRINTED : Feb-2-2012:16.59.09
PRODUCT : Classic 6500 S/N 84900024



TRC4M:
(Feb-2-2012:16.19.42)
1V/div,100µs/div
TRC2M:
(Feb-2-2012:16.19.42)
1V/div,100µs/div
TRC3M:
(Feb-2-2012:16.19.42)
50mV/div,100µs/div
TRC1M:
(Feb-2-2012:16.19.42)
50mV/div,100µs/div

TR4M
CURSOR : TRC2 +1.87V
+224.0055µs
CURSOR : TRC1 +52.67mV
+224.0055µs


hp
HORIZONTAL
2.00 us/div
100 ns/div
delay
-800.0 ns
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
25 MSa/s
sample clock
c3
c2
c1
-800.0 ns
9.2000 us
19.2000 us
2.00 us/div
realtime
y2(2) 2.03125 V
y1(3) -140.625 mV
delta y 2.17188 V
x2(2) 11.6600 us
x1(3) 11.5612 us
delta x 98.799 ns
1/delta x 10.1216 MHz


hp
EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 3
adjust center
level 2.50000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
EDGE,CHAN3 2.50000 V
-155.00 us
95.00 us
345.00 us
50.0 us/div
realtime
y2(2) 0.00000 V
y1(4) 2.50000 V
delta y -2.50000 V
x2(2) 225.600 us
x1(4) 224.006 us
delta x 1.59358 us
1/delta x 627.516 kHz

40 mm GUN DATA SHEET

Shot No. 1077 Date 2/14/12

Target:

Sample Material: Forsterite Single Crystal
Type of Measurement: Pre-heated EOS (2000 °C)
Expected Velocity: 1.50 km/sec.

Projectile:

Flyer Material: Mo (#18) Thickness: 0.1005 in. Weight: 20.4854 gms.
Projectile Material: LEXAN Length: 2.9990 in. Dia: 1.5610 in.
Weight: 97.6799 gms. Corrected Weight: 93.6799 gms. (-4gm)

Powder Charge:

Primer Type (to be inserted into 30/06 shell): CCI Large Rifle
Primer Powder Weight: 3.0 gms. Powder Type: Hercules 2400
Main Charge Weight: 132.089 gms. Powder Type: IMR4360 C/M: 1.41

Laser Distances:

Beam I to Muzzle: 68.40 / 68.40 cm.
Beam II to Muzzle: 43.70 / 43.8 cm.
Beam III to Muzzle: 2.05 / 2.05 cm.
Beam III to Target: 61.19 / 61.18 mm.

Co-axial Pin Height: - in.
Shim Thickness: - in.
Total Height: - cm.
Corrected III to Target Distance: - cm.

Estimated Times:

Beam I to II: 171.0 µsec.
Beam II to III: 298.7 µsec.
Beam III to Target: 40.79 µsec.

Actual Beam Distances:

Beam I to II: 0.2565 m.
Beam II to III: 0.4480 m.
Beam III to Target 0.061185 m.
Fudge distance: 0.044179 m.

Delays:

Xenon Lamp Delay: -6.127 µsec.
X-ray 1 to 2 Interval: 19.035 µsec.

Lamp Triggered by Laser No.: 3
Camera dial 260 for 2000 ns streak

Notes:

Temp: 2000 C; 6:40 min; .143 sig; 7.5 kV

CL

40 mm GUN

Recorded Data:

Backup Counter X-ray Interval: 18.571 µsec.
UDC 313.65 µsec
Counter 6 X-ray interval 18.141 µsec
Tank/Pump Pressure: 105/110 µm.

HP6-1 30.60 ns* 27.8 KV
HP6-2 18.602 µsec 27.6 KV
HP6-3 29.682 µsec
HP6-4 ——— µsec

HP5-1 -186.354 µsec
HP5-2 -186.296 µsec
HP5-3 4.0 ns*
HP5-4 313.802 µsec

GS7-1 -10.299 µsec
GS7-2 -195.50 ns*
GS7-3 303.462 µsec
GS7-4 313.600 µsec

Measured Shot Velocities:

Velocity, X-ray: _____ m/sec.

Backup Velocity, X-ray : _____ m/s
UDC : 1428.36 m/sec
↑ slower than expected...

SETUP: SHOT for scopes

HP6
trig: Ch1 xray 1 50V+ (5V/div)
- second hump (above 30V for 30ns) –lvl 10V+
Ch2 xray2 50V+ -(5V/div)
Ch3 cam monitor -- -1.75V - (500mV/div)
~~Ch4 photodiode—peak brightness—(200mV/div)~~
TOTAL TIME (from wksht): 29 us
Set time 65 us (100 ns/div)
Delay from trig -20 us (need: 0)

HP5
trig Ch3 laser 2 4V TTL -- jog in sig ~2.5V (2V/div)
Ch1 laser1 analog -- downgoing 150mV (50mV/div)
Ch2 laser 1 TTL, 4V -- level 2.5V+ (2V/ div)
Ch4 laser 3 4V TTL -- jog in sig ~2.5V (2V/div)
TOTAL TIME (from wksht): 479 us
Set time ~~0~~ 1310 us (2 µs /div)
Delay from trig -350 us (need: -181)

GS7
trig: Ch2 laser 2 TTL -- 4V+ (1V/div)
Ch1 laser 2 analog -- -150mV (50mV/div) ~180 mV
Ch3 laser 3 analog -- -150mV(50mV/div) ~ 130 mV
Ch4 laser 3 TTL –4V+ (1V/div)
TOTAL TIME (from wksht): 298 us
Set time 1000 us (M: 100 us)
Pretrigger view 9.8 %

40 mm GUN SIM

Recorded Data:

Backup Counter X-ray Interval: 18.759 µsec.
UDC 220.58 µsec
Counter 6 X-ray interval 18.187 µsec

HP6-1 30.20 ns* 27.65 KV (2nd hump)
HP6-2 18.789 µsec 27.65 KV
HP6-3 20.736 µsec
HP6-4 _____ µsec

HP5-1 -2.090 µsec
HP5-2 218.370 µsec
HP5-3 10 ns*
HP5-4 220.490 µsec

Measured Shot Velocities:

UDC : 2031.0 m/sec
Cal frequency 147.8950 1 MHz

SETUP: SIM for scopes

HP6

trig: Ch1 xray 1 50V+ (5V/div)

- second hump (above 30V for 30ns) –lvl 10V+

Ch2 xray2 50V+ -(5V/div)

Ch3 cam monitor ---1.75V - (500mV/div)

~~Ch4 photodiode—peak brightness—(200mV/div)~~

TOTAL TIME (from wksht): 29 us

Set time 65 us (100 ns/div)

Delay from trig -20 us (need: 0)

HP5

trig Ch3 laser 2 5V TTL -- jog in sig ~2.5V (2V/div)

Ch1 Mag sim 1 -- zero crossing (6V) (2V/div)

Ch2 Mag sim 2 (2V/div)

Ch4 laser 3 5V TTL -- jog in sig ~2.5V (2V/div)

TOTAL TIME (from wksht): 300 us

Set time 1310 ~~[illegible]~~ us (2 µs ~~[illegible]~~/div)

Delay from trig -350 us (need: 0)

40 mm hot EOS shot Nominal Timeline Preshot 1077

V	1500			Laser1-Laser2 distance	0.2565	0.25650	
cable time	75	ch1	ch2	Laser2-Laser3 distance	0.448	0.4480	
photodiode intrinsic delays	[redacted]			Laser3-target distance	0.061185	0.061185	includes spacer
UDC extra count lag	118	2140	2140	Laser3-target fudge	0.044479		
pulse translator delay	150			Laser3-Xray2 % of Laser3-target	75		
X-ray 1 program delay	0	971	X-ray 1 delay amp intrinsic				
X-ray 2 program delay	19035.5	1216	X-ray 2 delay amp intrinsic				
X-ray 1 pulser delay	426			Us(Mo)	5853.39269		
X-ray 2 pulser delay	887			driver thickness	0.00105253		
Lamp trigger to peak bright	[redacted]			sample thickness	0.00254		
HV3 program delay	-6127			cap thickness	0.00076987		
Camera intrinsic delay	107			estimated sample+cover time	573.936201		
Streak duration	2000						
d dead streak before driver	750						

t (ns)	flyer x (m)	shock front (m)	event	SIM	SHOT
-171000	-0.2565		Laser 1 actual interrupt		HP5-1
-170800	-0.2562		Laser 1 TTL out		
-170725	-0.2560875		Laser 1 TTL at UDC		HP5-2
0	0		Laser 2 actual interrupt		GS7-1
10178	0.015267		Laser 2 TTL out (shot)		GS7-2 & Trig
8113	0.0121695		Magnet Sim 1 analog (sim)	HP5-1	
10253	0.0153795		Laser 2 TTL at UDC, start up-count	HP5-3 & Trig, UDC start	HP5-3 & Trig, UDC start
298667	0.448		Laser 3 actual interrupt		GS7-3
308858	0.4632865		Laser 3 TTL out		GS7-4
306793	0.460189		Magnet Sim 2 analog (sim)	HP5-2	
308933	0.463399		Laser 3 TTL at UDC (start down-count) and pulse translat	HP5-4, UDC stop	HP5-4, UDC stop
309158	0.4637365		Pulse translator out reaches X-ray delay amps 1 & 2		
310129	0.465193		Delay amp 1 out to X-ray 1	Start counter 6	Start counter 6
310555	0.465832		X-ray 1 fires		
310630	0.4659445		X-ray 1 pulse monitor at counter 4b	HP6-1 & Trig, start 4b	HP6-1 & Trig, start 4b
329409	0.49411375		Delay amp 2 out to X-ray 2	stop counter 6	stop counter 6
330296	0.49388875		X-ray 2 fires		
330371	0.49555675		X-ray 2 pulse monitor at counters 4b	HP6-2, stop counter 4b	HP6-2, stop counter 4b
332577	0.49886622		HV3 out to lamp		
338704	0.50805672		UDC zero time, HV1 out to camera		
338779	0.50816922		Trigger at camera		
338886	0.50832972		Begin Streak		
338961	0.50844222		Camera Monitor reaches control lab	HP6-3	HP6-3
339854	0.50978172		Lamp Peak Bright	HP6-4	HP6-4
339457	0.509185	0	IMPACT		
339636		0.001052525	Driver arrival on streak	Driver cutoff on streak	750
340210		0.004411999	Sample cutoff on streak	Sample cutoff on sreak	1324
340886		0.008369266	End Streak		

	rho0	Co	s		
Cold Mo	10206	5033	1.28946405		
Hot Mo	9785	4857.9	1.2875	2273	
Liquid Forsterite	[redacted]				

				up	P	Us
driver	562.0825943	-138382160	1.06661E+11	773.198206	44.2852732	5853.39269
sample	8799.754822	-96507528	1.03634E+11	1206.59028	17.6072222	5499.1068
cap	-8799.75482	-75876552	46274417614	571.928918	31.3072856	5594.25848

Cold Mo	10206	5033	1.28946405	300	
Hot Mo	9961.5	4927.8728	1.288702471	1300	
	9937	4918.5831	1.28837124	1407	
	9913	4908.7717	1.2882417	1508	
	9875	4893.13	1.28807834	1659	
			1.2881	1873	
2273K	10278.85	5063.57067			

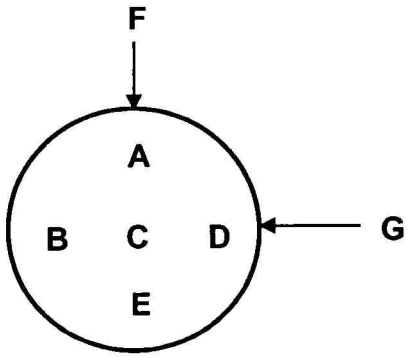
			-0.2432346	10278.8461
			0.00084228	1.11652606
			0.99996403	0.9080814

	SIM	SHOT			
HP6 1	0	0		-0.1030929	5063.57067
HP6 2	19742	19742		0.001035	1.37199182
HP6 3	28332	28332		0.99969772	1.11585417
HP6 4	29225	29225			
UDC upcount:	298680	298680			
HP5 1	-2140	-181253			
HP5 2	296540	-180978			
HP5 3	0	0			
HP5 4	298680	298680	479933	300820	
GS7 1		-275			
GS7 2		0			
GS7 3		288489			
GS7 4		298680		298955	
Counter 4b:	19742	19742			
Counter 6:	19281	19281			

SHOT No.

FLYER PLATE MATERIAL: **Mo # 18** 1/31/2012

Measurement done by: Russ



DIGITAL MICROMETER THICKNESS MESUREMENT		DIGITAL MICROMETER DIAMETER MEASUREMENT	
A	0.10030	F	1.24950
A	0.10040	F	1.25000
B	0.10040	G	1.25000
B	0.10035	G	1.25000
C	0.10045		
C	0.10050		
D	0.10055		
D	0.10060		
E	0.10050		
E	0.10055		

Statistic for thickness

N	10
MAX	0.10060
MIN	0.10035
Range	0.00025
MEAN	0.100464286
	2.551792857
STDEV	8.99735E-05

Statistic for Diameter (F-G)

N	4	
MAX	1.25000	
MIN	1.24950	
Range	0.00050	
MEAN	1.2498750	inch
	31.7468250	mm
STDEV	0.00025	

	Sample in Air	Crystal Density	
1	20.4854	10.23	
2	20.4855	10.229	
3	20.4853	10.229	

Density measurement calculated on the Mettler Toledo XS250 Balance

THICKNESS	0.100464286	±	in
FLATNESS:	0.00025	in.	
VOLUME:	2.0199	9.27E-04	cm^3
CRYSTAL DENSITY:	10.2293	#DIV/0!	$grams/cm^3$
BULK DENSITY:	10.1416	#DIV/0!	$grams/cm^3$

DENSITIES CHECKED BY: _____ on _____

MEASUREMENT CHECKED BY: _____ on _____

SHOT No. __1077_____ tip used: .7mm long/ flat tip

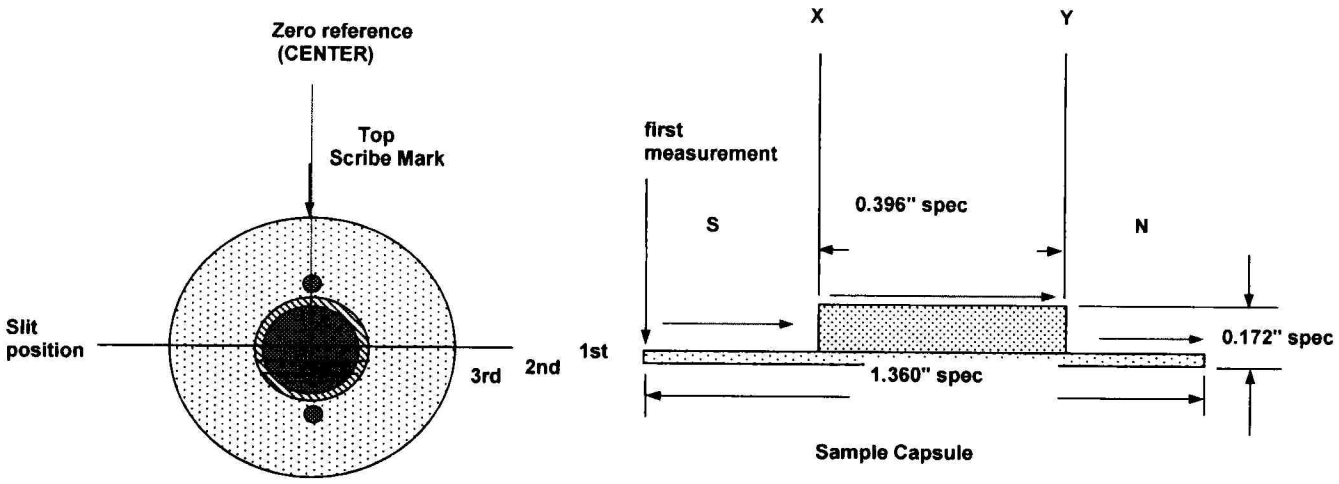
SAMPLE CAPSULE: 19 note: the platform on which the measurement was taken

SAMPLE MATERIAL: deviates from flat by +0.013 max.

direction of measurement

2.0325 4.065

THICKNESS PROFILE (Not re-polished, but final surface) 2.16 4.32



First Run Horizontal (X) thru the center with 0.100 MM increment

1st Reading

Average thickness reading = 0.00004

Second Run Horizontal (-y) 0.100 MM Below the center with 0.100 MM increment

2nd Reading

Average thickness reading = -0.00004

Third Run Horizontal (-y) 0.200 MM Below the center with 0.100 MM increment

3rd Reading

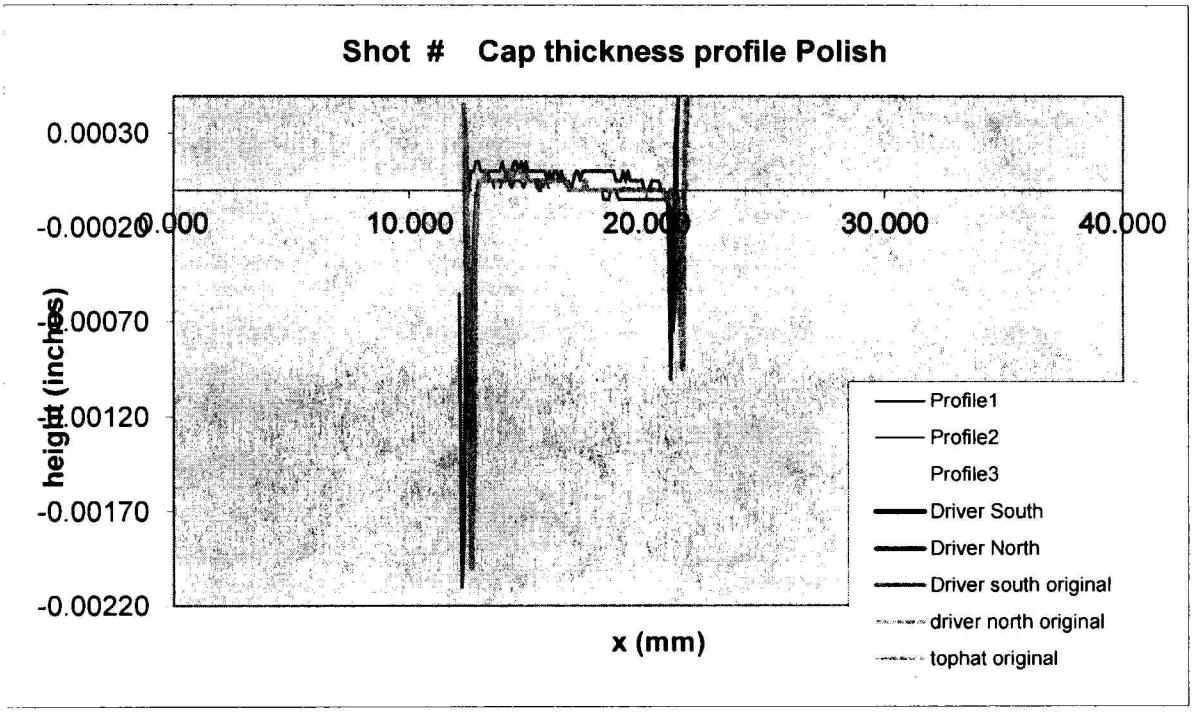
Average thickness reading = 0.00000

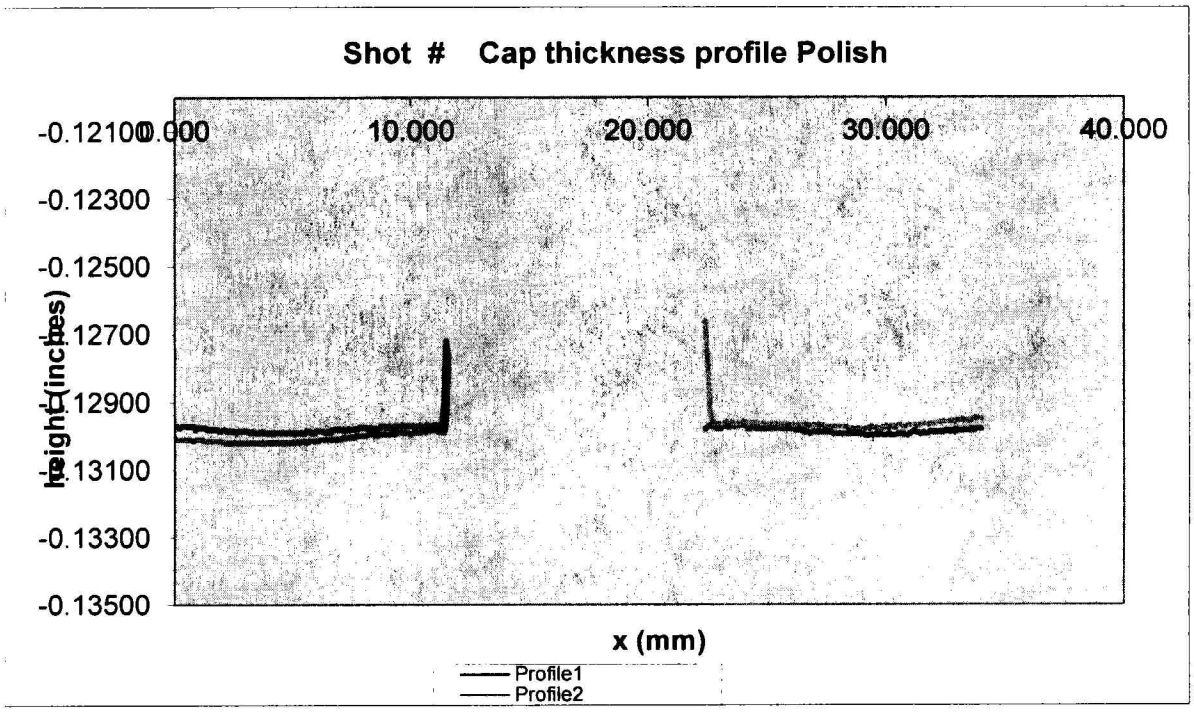
Note: Measurement from reference zero point from the base is = **0.1713** Inches
4.3498 mm

Average thickness of the driver Plate = 0.0414 Inches
1.0525 mm

Thickness of the Carbon Deposited on the coil side is = nm

Thickness of the C Deposited on the Projectile side is = nm


Shot # Cap thickness profile Polish
0.00030
-0.00020
-0.00070
-0.00120
-0.00170
-0.00220
0.000
10.000
20.000
30.000
40.000
height (inches)
x (mm)
Profile1
Profile2
Profile3
Driver South
Driver North
Driver south original
driver north original
tophat original


Shot # Cap thickness profile Polish
-0.12100
-0.12300
-0.12500
-0.12700
-0.12900
-0.13100
-0.13300
-0.13500
0.000
10.000
20.000
30.000
40.000
height (inches)
x (mm)
Profile1
Profile2

1. First Run Horizontal (X) thru the center with 0.100 MM increment 2. Second Run Horizontal (-y) 1.00 MM Below the cente

3. Third Run Horizontal (-y) 2.00 MM Below the center with 0.100 MM increment

Number	Reading	abs dist.		Number	Reading	abs dist.		Number
3	Distance			of	Distance			of
Reading	mm	mm	South (left side)	Reading	mm	mm	North(right	Reading
1	0.000	17.000	-0.1297	225	22.400	-5.400	-0.1298	118
2	0.100	16.900	-0.1297	226	22.500	-5.500	-0.1298	119
3	0.200	16.800	-0.1298	227	22.600	-5.600	-0.1297	120
4	0.300	16.700	-0.1297	228	22.700	-5.700	-0.1298	121
5	0.400	16.600	-0.1297	229	22.800	-5.800	-0.1298	122
6	0.500	16.500	-0.1297	230	22.900	-5.900	-0.1298	123
7	0.600	16.400	-0.1297	231	23.000	-6.000	-0.1298	124
8	0.700	16.300	-0.1297	232	23.100	-6.100	-0.1298	125
9	0.800	16.200	-0.1297	233	23.200	-6.200	-0.1298	126
10	0.900	16.100	-0.1298	234	23.300	-6.300	-0.1297	127
11	1.000	16.000	-0.1298	235	23.400	-6.400	-0.1298	128
12	1.100	15.900	-0.1298	236	23.500	-6.500	-0.1297	129
13	1.200	15.800	-0.1298	237	23.600	-6.600	-0.1298	130
14	1.300	15.700	-0.1298	238	23.700	-6.700	-0.1297	131
15	1.400	15.600	-0.1298	239	23.800	-6.800	-0.1297	132
16	1.500	15.500	-0.1298	240	23.900	-6.900	-0.1297	133
17	1.600	15.400	-0.1298	241	24.000	-7.000	-0.1297	134
18	1.700	15.300	-0.1298	242	24.100	-7.100	-0.1297	135
19	1.800	15.200	-0.1298	243	24.200	-7.200	-0.1298	136
20	1.900	15.100	-0.1299	244	24.300	-7.300	-0.1298	137
21	2.000	15.000	-0.1299	245	24.400	-7.400	-0.1298	138
22	2.100	14.900	-0.1298	246	24.500	-7.500	-0.1298	139
23	2.200	14.800	-0.1299	247	24.600	-7.600	-0.1298	140
24	2.300	14.700	-0.1299	248	24.700	-7.700	-0.1298	141
25	2.400	14.600	-0.1299	249	24.800	-7.800	-0.1298	142
26	2.500	14.500	-0.1299	250	24.900	-7.900	-0.1298	143
27	2.600	14.400	-0.1299	251	25.000	-8.000	-0.1298	144
28	2.700	14.300	-0.1299	252	25.100	-8.100	-0.1298	145
29	2.800	14.200	-0.1299	253	25.200	-8.200	-0.1298	146
30	2.900	14.100	-0.1299	254	25.300	-8.300	-0.1298	147
31	3.000	14.000	-0.1299	255	25.400	-8.400	-0.1298	148
32	3.100	13.900	-0.1299	256	25.500	-8.500	-0.1298	149
33	3.200	13.800	-0.1299	257	25.600	-8.600	-0.1298	150
34	3.300	13.700	-0.1299	258	25.700	-8.700	-0.1298	151
35	3.400	13.600	-0.1299	259	25.800	-8.800	-0.1298	152
36	3.500	13.500	-0.1299	260	25.900	-8.900	-0.1298	153
37	3.600	13.400	-0.1299	261	26.000	-9.000	-0.1298	154
38	3.700	13.300	-0.1299	262	26.100	-9.100	-0.1298	155
39	3.800	13.200	-0.1299	263	26.200	-9.200	-0.1299	156
40	3.900	13.100	-0.1299	264	26.300	-9.300	-0.1299	157
41	4.000	13.000	-0.1299	265	26.400	-9.400	-0.1299	158
42	4.100	12.900	-0.1299	266	26.500	-9.500	-0.1299	159
43	4.200	12.800	-0.1299	267	26.600	-9.600	-0.1299	160
44	4.300	12.700	-0.1299	268	26.700	-9.700	-0.1299	161
45	4.400	12.600	-0.1299	269	26.800	-9.800	-0.1300	162
46	4.500	12.500	-0.1299	270	26.900	-9.900	-0.1299	163
47	4.600	12.400	-0.1299	271	27.000	-10.000	-0.1299	164
48	4.700	12.300	-0.1299	272	27.100	-10.100	-0.1299	165
49	4.800	12.200	-0.1299	273	27.200	-10.200	-0.1299	166
50	4.900	12.100	-0.1299	274	27.300	-10.300	-0.1299	167
51	5.000	12.000	-0.1299	275	27.400	-10.400	-0.1299	168
52	5.100	11.900	-0.1299	276	27.500	-10.500	-0.1299	169
53	5.200	11.800	-0.1299	277	27.600	-10.600	-0.1299	170
54	5.300	11.700	-0.1299	278	27.700	-10.700	-0.1299	171

55	5.400	11.600	-0.1299	279	27.800	-10.800	-0.1300	172
56	5.500	11.500	-0.1299	280	27.900	-10.900	-0.1300	173
57	5.600	11.400	-0.1299	281	28.000	-11.000	-0.1300	174
58	5.700	11.300	-0.1299	282	28.100	-11.100	-0.1300	175
59	5.800	11.200	-0.1299	283	28.200	-11.200	-0.1300	176
60	5.900	11.100	-0.1299	284	28.300	-11.300	-0.1300	177
61	6.000	11.000	-0.1299	285	28.400	-11.400	-0.1300	178
62	6.100	10.900	-0.1299	286	28.500	-11.500	-0.1300	179
63	6.200	10.800	-0.1299	287	28.600	-11.600	-0.1300	180
64	6.300	10.700	-0.1299	288	28.700	-11.700	-0.1300	181
65	6.400	10.600	-0.1299	289	28.800	-11.800	-0.1300	182
66	6.500	10.500	-0.1299	290	28.900	-11.900	-0.1300	183
67	6.600	10.400	-0.1299	291	29.000	-12.000	-0.1300	184
68	6.700	10.300	-0.1298	292	29.100	-12.100	-0.1300	185
69	6.800	10.200	-0.1298	293	29.200	-12.200	-0.1300	186
70	6.900	10.100	-0.1298	294	29.300	-12.300	-0.1300	187
71	7.000	10.000	-0.1298	295	29.400	-12.400	-0.1300	188
72	7.100	9.900	-0.1298	296	29.500	-12.500	-0.1300	189
73	7.200	9.800	-0.1299	297	29.600	-12.600	-0.1300	190
74	7.300	9.700	-0.1298	298	29.700	-12.700	-0.1300	191
75	7.400	9.600	-0.1298	299	29.800	-12.800	-0.1300	192
76	7.500	9.500	-0.1298	300	29.900	-12.900	-0.1300	193
77	7.600	9.400	-0.1298	301	30.000	-13.000	-0.1300	194
78	7.700	9.300	-0.1298	302	30.100	-13.100	-0.1300	195
79	7.800	9.200	-0.1298	303	30.200	-13.200	-0.1300	196
80	7.900	9.100	-0.1298	304	30.300	-13.300	-0.1300	197
81	8.000	9.000	-0.1298	305	30.400	-13.400	-0.1300	198
82	8.100	8.900	-0.1298	306	30.500	-13.500	-0.1300	199
83	8.200	8.800	-0.1298	307	30.600	-13.600	-0.1300	200
84	8.300	8.700	-0.1298	308	30.700	-13.700	-0.1300	201
85	8.400	8.600	-0.1298	309	30.800	-13.800	-0.1300	202
86	8.500	8.500	-0.1298	310	30.900	-13.900	-0.1300	203
87	8.600	8.400	-0.1298	311	31.000	-14.000	-0.1300	204
88	8.700	8.300	-0.1298	312	31.100	-14.100	-0.1299	205
89	8.800	8.200	-0.1297	313	31.200	-14.200	-0.1299	206
90	8.900	8.100	-0.1297	314	31.300	-14.300	-0.1299	207
91	9.000	8.000	-0.1298	315	31.400	-14.400	-0.1300	208
92	9.100	7.900	-0.1297	316	31.500	-14.500	-0.1300	209
93	9.200	7.800	-0.1298	317	31.600	-14.600	-0.1299	210
94	9.300	7.700	-0.1297	318	31.700	-14.700	-0.1300	211
95	9.400	7.600	-0.1297	319	31.800	-14.800	-0.1299	212
96	9.500	7.500	-0.1297	320	31.900	-14.900	-0.1299	213
97	9.600	7.400	-0.1297	321	32.000	-15.000	-0.1299	214
98	9.700	7.300	-0.1297	322	32.100	-15.100	-0.1299	215
99	9.800	7.200	-0.1297	323	32.200	-15.200	-0.1299	216
100	9.900	7.100	-0.1297	324	32.300	-15.300	-0.1299	217
101	10.000	7.000	-0.1297	325	32.400	-15.400	-0.1299	218
102	10.100	6.900	-0.1297	326	32.500	-15.500	-0.1299	219
103	10.200	6.800	-0.1298	327	32.600	-15.600	-0.1299	220
104	10.300	6.700	-0.1297	328	32.700	-15.700	-0.1299	221
105	10.400	6.600	-0.1297	329	32.800	-15.800	-0.1299	222
106	10.500	6.500	-0.1298	330	32.900	-15.900	-0.1299	223
107	10.600	6.400	-0.1297	331	33.000	-16.000	-0.1299	224
108	10.700	6.300	-0.1297	332	33.100	-16.100	-0.1299	
109	10.800	6.200	-0.1297	333	33.200	-16.200	-0.1299	
110	10.900	6.100	-0.1297	334	33.300	-16.300	-0.1299	
111	11.000	6.000	-0.1297	335	33.400	-16.400	-0.1299	
112	11.100	5.900	-0.1297	336	33.500	-16.500	-0.1299	
113	11.200	5.800	-0.1297	337	33.600	-16.600	-0.1298	
114	11.300	5.700	-0.1297	338	33.700	-16.700	-0.1299	
115	11.400	5.600	-0.1291	339	33.800	-16.800	-0.1298	
116	11.500	5.500	-0.1272	340	33.900	-16.900	-0.1298	
117	11.600	5.400	-0.1279	341	34.000	-17.000	-0.1298	

r with 0.100 MM increment

2.173

Reading Distance	abs dist.	1st Run Reading	2nd Run Reading	3 rd Run Reading
mm	mm	Inches	Inches	Inches
11.700	5.300			
11.800	5.200			
11.900	5.100			
12.000	5.000			
12.100	4.900			
12.200	4.800			
12.300	4.700	-0.00055		
12.400	4.600	-0.00210		
12.500	4.500	-0.00185	0.00020	
12.600	4.400	-0.00020	-0.00090	
12.700	4.300	0.00000	-0.00145	
12.800	4.200	0.00010	-0.00085	
12.900	4.100	0.00010	-0.00025	0.00000
13.000	4.000	0.00015	0.00000	-
13.100	3.900	0.00015	0.00005	-
13.200	3.800	0.00010	0.00005	-
13.300	3.700	0.00010	0.00005	-
13.400	3.600	0.00010	0.00010	-
13.500	3.500	0.00010	0.00010	-
13.600	3.400	0.00010	0.00005	-
13.700	3.300	0.00010	0.00005	-
13.800	3.200	0.00010	0.00000	-
13.900	3.100	0.00010	0.00000	-
14.000	3.000	0.00010	0.00000	-
14.100	2.900	0.00015	0.00005	-
14.200	2.800	0.00010	0.00005	-
14.300	2.700	0.00010	0.00005	-
14.400	2.600	0.00010	0.00005	-
14.500	2.500	0.00010	0.00000	-
14.600	2.400	0.00015	0.00005	-
14.700	2.300	0.00015	0.00005	-
14.800	2.200	0.00010	0.00005	-
14.900	2.100	0.00015	0.00005	-
15.000	2.000	0.00010	0.00000	-
15.100	1.900	0.00015	0.00005	-
15.200	1.800	0.00010	0.00005	-
15.300	1.700	0.00010	0.00005	-
15.400	1.600	0.00010	0.00005	-
15.500	1.500	0.00010	0.00005	-
15.600	1.400	0.00010	0.00000	-
15.700	1.300	0.00010	0.00005	-
15.800	1.200	0.00010	0.00000	-
15.900	1.100	0.00010	0.00005	-
16.000	1.000	0.00005	0.00005	-
16.100	0.900	0.00010	0.00000	-
16.200	0.800	0.00005	0.00000	-
16.300	0.700	0.00010	0.00000	-
16.400	0.600	0.00010	0.00000	-
16.500	0.500	0.00005	0.00000	-
16.600	0.400	0.00010	0.00000	-
16.700	0.300	0.00005	0.00000	-
16.800	0.200	0.00005	0.00000	-
16.900	0.100	0.00005	0.00000	-
17.000	0.000	0.00000	0.00000	-

17.100	-0.100	0.00005	0.00000	-
17.200	-0.200	0.00010	0.00000	-
17.300	-0.300	0.00010	0.00000	-
17.400	-0.400	0.00005	0.00000	-
17.500	-0.500	0.00010	0.00000	-
17.600	-0.600	0.00010	0.00000	-
17.700	-0.700	0.00010	0.00000	-
17.800	-0.800	0.00010	0.00000	-
17.900	-0.900	0.00010	0.00000	-
18.000	-1.000	0.00010	0.00000	-
18.100	-1.100	0.00010	0.00000	-
18.200	-1.200	0.00010	0.00000	-
18.300	-1.300	0.00010	0.00000	-
18.400	-1.400	0.00010	-0.00005	-
18.500	-1.500	0.00010	-0.00005	-
18.600	-1.600	0.00010	-0.00005	-
18.700	-1.700	0.00010	0.00000	-
18.800	-1.800	0.00010	0.00000	-
18.900	-1.900	0.00005	0.00000	-
19.000	-2.000	0.00005	-0.00005	-
19.100	-2.100	0.00005	-0.00005	-
19.200	-2.200	0.00010	-0.00005	-
19.300	-2.300	0.00005	-0.00005	-
19.400	-2.400	0.00010	-0.00005	-
19.500	-2.500	0.00005	-0.00005	-
19.600	-2.600	0.00005	-0.00005	-
19.700	-2.700	0.00005	-0.00005	-
19.800	-2.800	0.00005	-0.00005	-
19.900	-2.900	0.00005	-0.00005	-
20.000	-3.000	0.00005	-0.00005	-
20.100	-3.100	0.00000	-0.00005	-
20.200	-3.200	0.00000	-0.00005	-
20.300	-3.300	0.00000	-0.00005	-
20.400	-3.400	0.00005	-0.00005	-
20.500	-3.500	0.00005	-0.00005	-
20.600	-3.600	0.00005	-0.00005	-
20.700	-3.700	0.00005	-0.00005	-
20.800	-3.800	0.00000	-0.00005	-
20.900	-3.900	0.00000	-0.00005	-
21.000	-4.000	0.00000	-0.00005	-
21.100	-4.100	-0.00010	-0.00005	-
21.200	-4.200	-0.00100	-0.00010	-
21.300	-4.300	-0.00045	-0.00075	-
21.400	-4.400	0.00030	-0.00060	
21.500	-4.500	0.00045	0.00035	
21.600	-4.600	0.00065	0.00070	
21.700	-4.700	0.00070		
21.800	-4.800	0.00075		
21.900	-4.900			
22.000	-5.000			
22.100	-5.100			
22.200	-5.200			
22.300	-5.300			

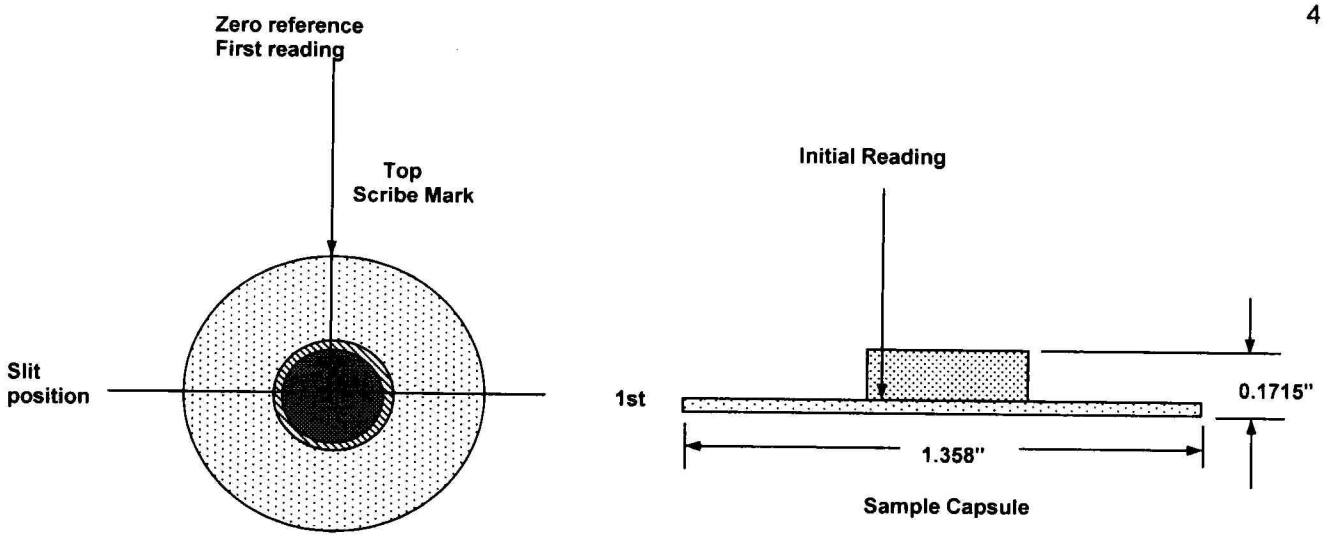
1077

SAMPLE CAPSULE: **19**

SAMPLE MATERIAL: **Molybdenum**

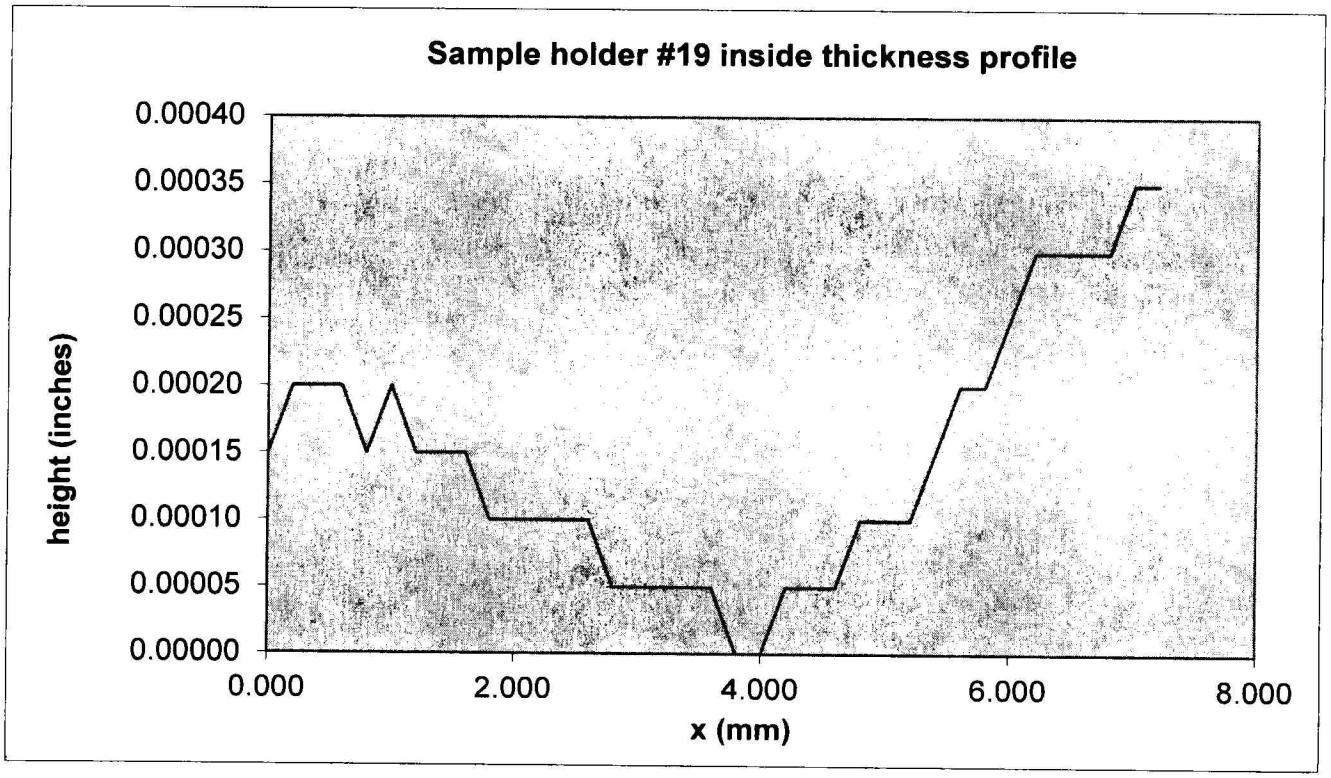
INSIDE THICKNESS PROFILE FOR SAMPLE HOLDER

4.8265
4.623



Average thickness reading = 0.00014

Note: The thickness of the reference zero point from the base is = **0.04305** Inches
1.09347 mm



Thickness Measurement of the Sample Holder (Slit Position) with 0.200 MM increment

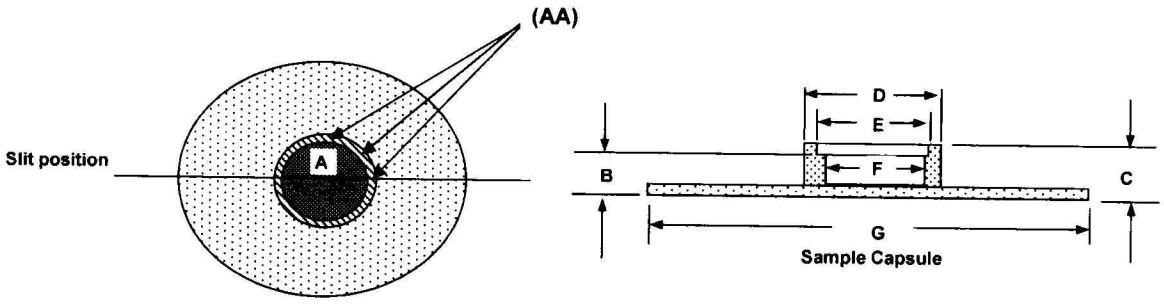
Number of Reading	Reading Distance mm	Reading Inches	abs. dis	
1	0.000	0.00015	3.6	south
2	0.200	0.00020	3.40	
3	0.400	0.00020	3.20	
4	0.600	0.00020	3.00	
5	0.800	0.00015	2.80	
6	1.000	0.00020	2.60	
7	1.200	0.00015	2.40	
8	1.400	0.00015	2.20	
9	1.600	0.00015	2.00	
10	1.800	0.00010	1.80	
11	2.000	0.00010	1.60	
12	2.200	0.00010	1.40	
13	2.400	0.00010	1.20	
14	2.600	0.00010	1.00	
15	2.800	0.00005	0.80	
16	3.000	0.00005	0.60	
17	3.200	0.00005	0.40	
18	3.400	0.00005	0.20	
19	3.600	0.00005	0.00	
20	3.800	0.00000	-0.20	
21	4.000	0.00000	-0.40	
22	4.200	0.00005	-0.60	
23	4.400	0.00005	-0.80	
24	4.600	0.00005	-1.00	
25	4.800	0.00010	-1.20	
26	5.000	0.00010	-1.40	
27	5.200	0.00010	-1.60	
28	5.400	0.00015	-1.80	
29	5.600	0.00020	-2.00	
30	5.800	0.00020	-2.20	
31	6.000	0.00025	-2.40	
32	6.200	0.00030	-2.60	
33	6.400	0.00030	-2.80	
34	6.600	0.00030	-3.00	
35	6.800	0.00030	-3.20	
36	7.000	0.00035	-3.40	
37	7.200	0.00035	-3.60	north

SHOT No.: 1077 post polish 11/18/2010

SAMPLE CAPSULE: 19

SAMPLE MATERIAL: Molybdenum

Cap(see attached sheet)



Before Sample Assembly

DIGITAL DEPTH GAUGE THICKNESS MEASUREMENT
Note: the inside of the sample capsule should be polish and the bottom side of the Cap

	inside
A	0.04130
A	0.04130
A	0.04135
A	0.04125
Avg	0.04130

After Welding the Total Thickness of the sample capsule & the cap is C before polishing

C	0.17140
C	0.17210
C	0.17220
C	0.17220
D	0.3965
D	0.3960

Measurement for (B) is taken at 45 degree intervals starting at the top and moving clockwise around the entire circumference of the inner lip. (see example AA)

B point 1(top)	0.14175
B point 2	0.14185
B point 3	0.14180
B point 4	0.14190
B point 5	0.14185
B point 6	0.14185
B point 7	0.14175
B point 8	0.14175

Statistics	
N	8
MAX	0.14190
MIN	0.14175
Range	0.00015
Average	0.14181

DIGITAL CALIFER DIAMETER MEASUREMENT

E	0.3540
E	0.3540
F	0.3155
F	0.3145
G	1.7485
G	1.7490
H	0.10051

MEASUREMENT BY:		Claire		
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.8	1.88200	10.65532	11.63431	0.8640	10.1948
2	21.8	1.88204	10.65544	11.63430	0.8640	10.1930
3	21.8	1.88200	10.65536	11.63438	0.8640	10.1952
	THICKNESS:			±	mm	
	FLATNESS:			mm		
	VOLUME:				cm^3	
	CRYSTAL DENSITY:		10.1943	1.17E-03	$grams/cm^3$	
	BULK DENSITY:				$grams/cm^3$	

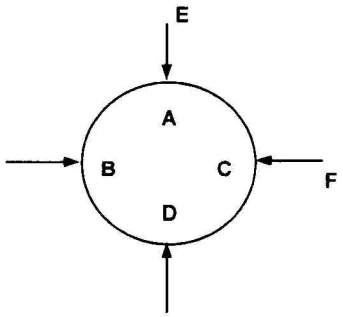
SHOT No. _____1077_____

LGG Moly Capsule Cap 11/18/2010

SAMPLE MATERIAL: Mo 19

Post polish

Thickness Measurement	
A	0.03035
A	0.03045
B	0.03030
B	0.03035
C	0.03030
C	0.03010
D	0.03030
D	0.03030



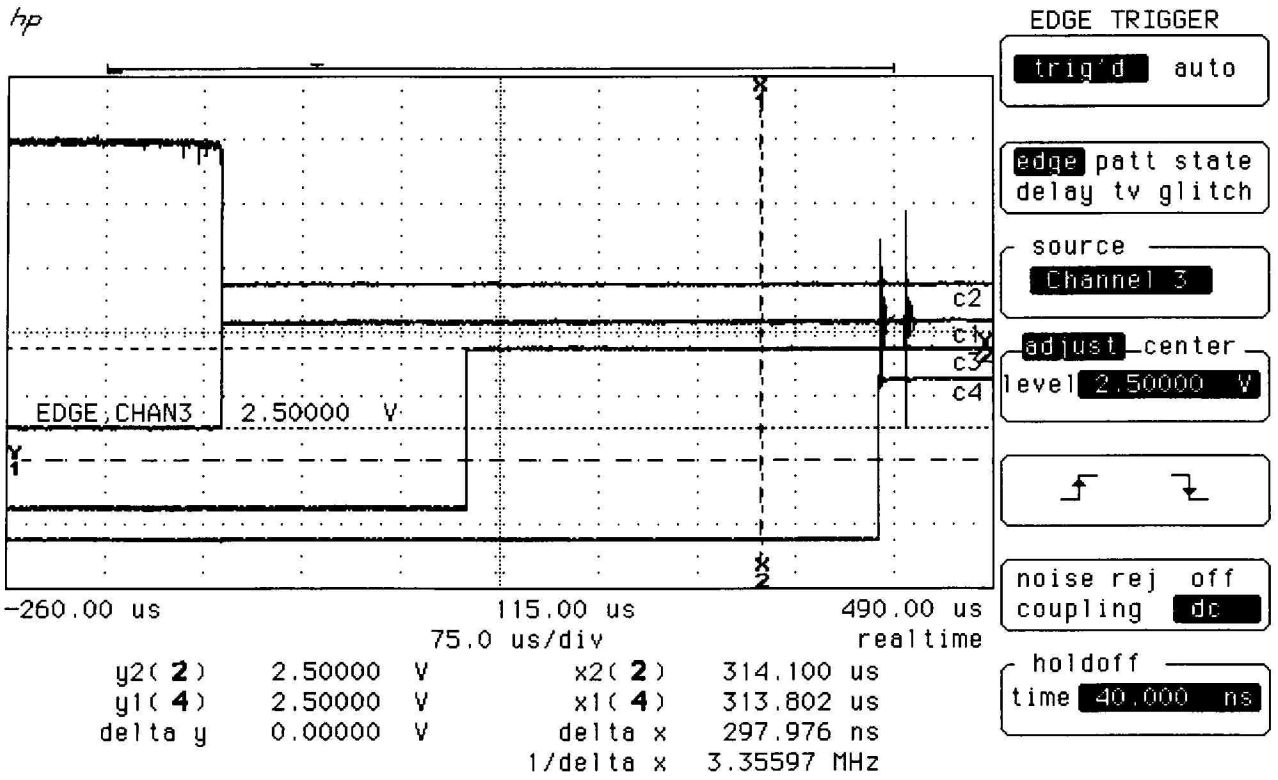
Diameter Measurement	
E	0.35400
E	0.35400
F	0.35400
F	0.35400
AVE	0.35400
Radius	0.1770

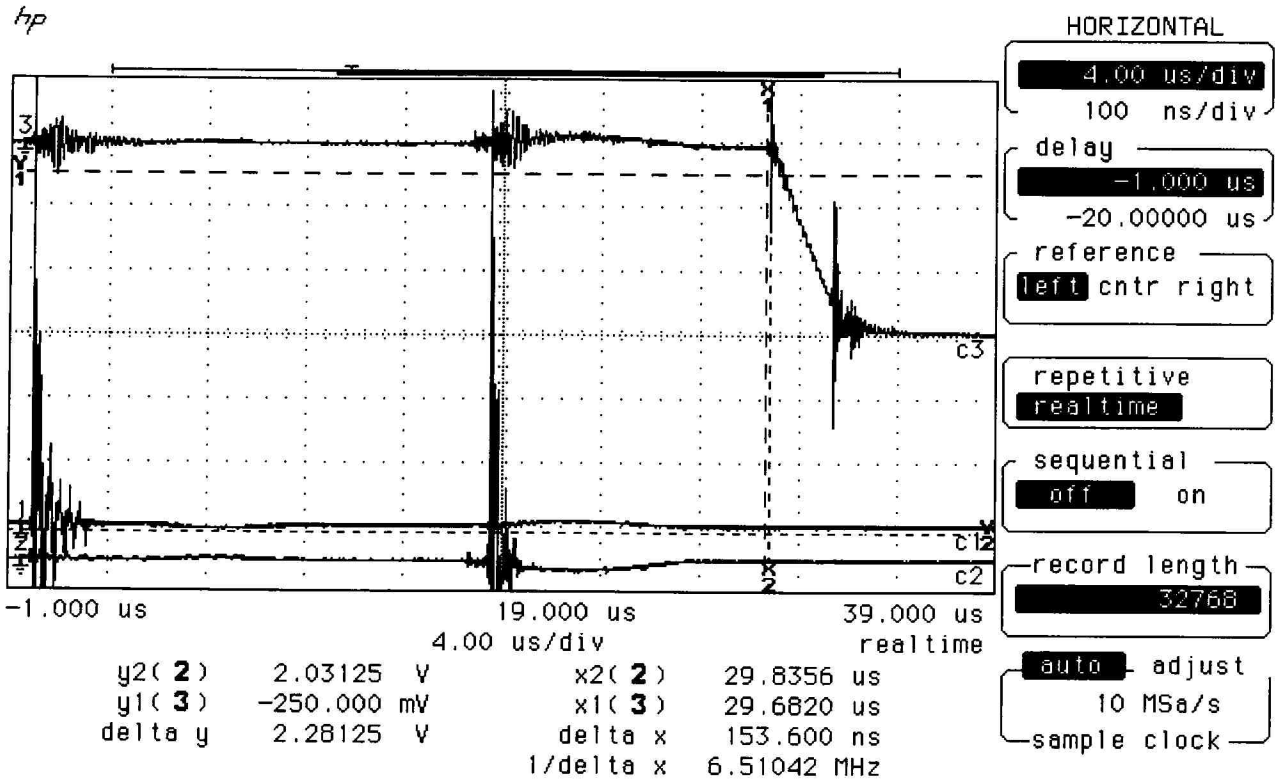
Statistic for thickness	
N	8
MAX	0.03045
MIN	0.0301
Range	0.00035
MEAN	0.03031
STDEV	9.79705E-05

Statistic for perimeter	
N	4
MAX	0.35400
MIN	0.354
Range	0
MEAN	0.354
STDEV	0

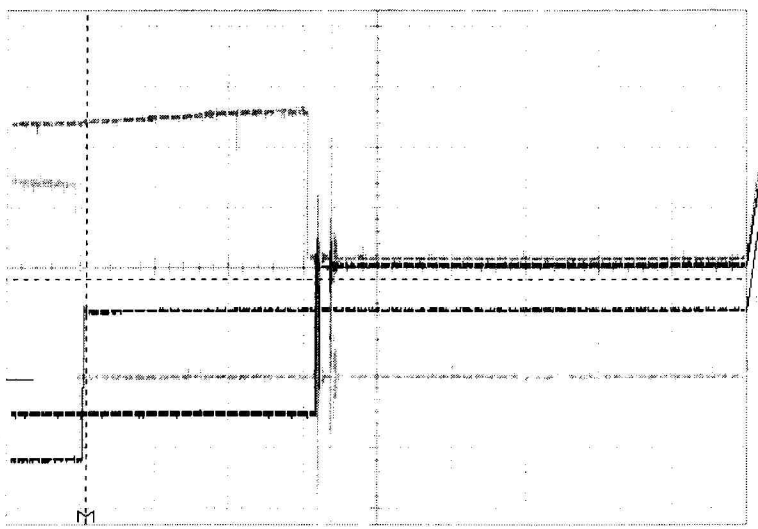
post-polish:

DENSITY MEASUREMENT BY:			Claire			
NO. OF TRIAL	TEMP °C	MASS OF BASKET (Toluene)	MASS OF SAMPLE IN AIR	MASS OF BASKET & SAMPLE (TOLUENE)	Density of Toluene	Crystal Density
1	21.5	1.88295	0.49730	2.33800	0.8643	10.1727
2	21.5	1.88307	0.49724	2.33805	0.8643	10.1691
3	21.5	1.88300	0.49725	2.33807	0.8643	10.1886
	THICKNESS:		0.03030625	±	mm	
	FLATNESS:		0.00035			
	VOLUME:		0.0489		cm^3	
	CRYSTAL DENSITY:		10.1768	0.01	$grams/cm^3$	
	BULK DENSITY:		10.1732		$grams/cm^3$	


hp
EDGE TRIGGER
trig'd auto
edge patt state
delay tv glitch
source
Channel 3
adjust center
level 2.50000 V
noise rej off
coupling dc
holdoff
time 40.000 ns
c2
c1
c3
c4
EDGE,CHAN3 2.50000 V
-260.00 us
115.00 us
490.00 us
75.0 us/div
realtime
y2(2) 2.50000 V
y1(4) 2.50000 V
delta y 0.00000 V
x2(2) 314.100 us
x1(4) 313.802 us
delta x 297.976 ns
1/delta x 3.35597 MHz

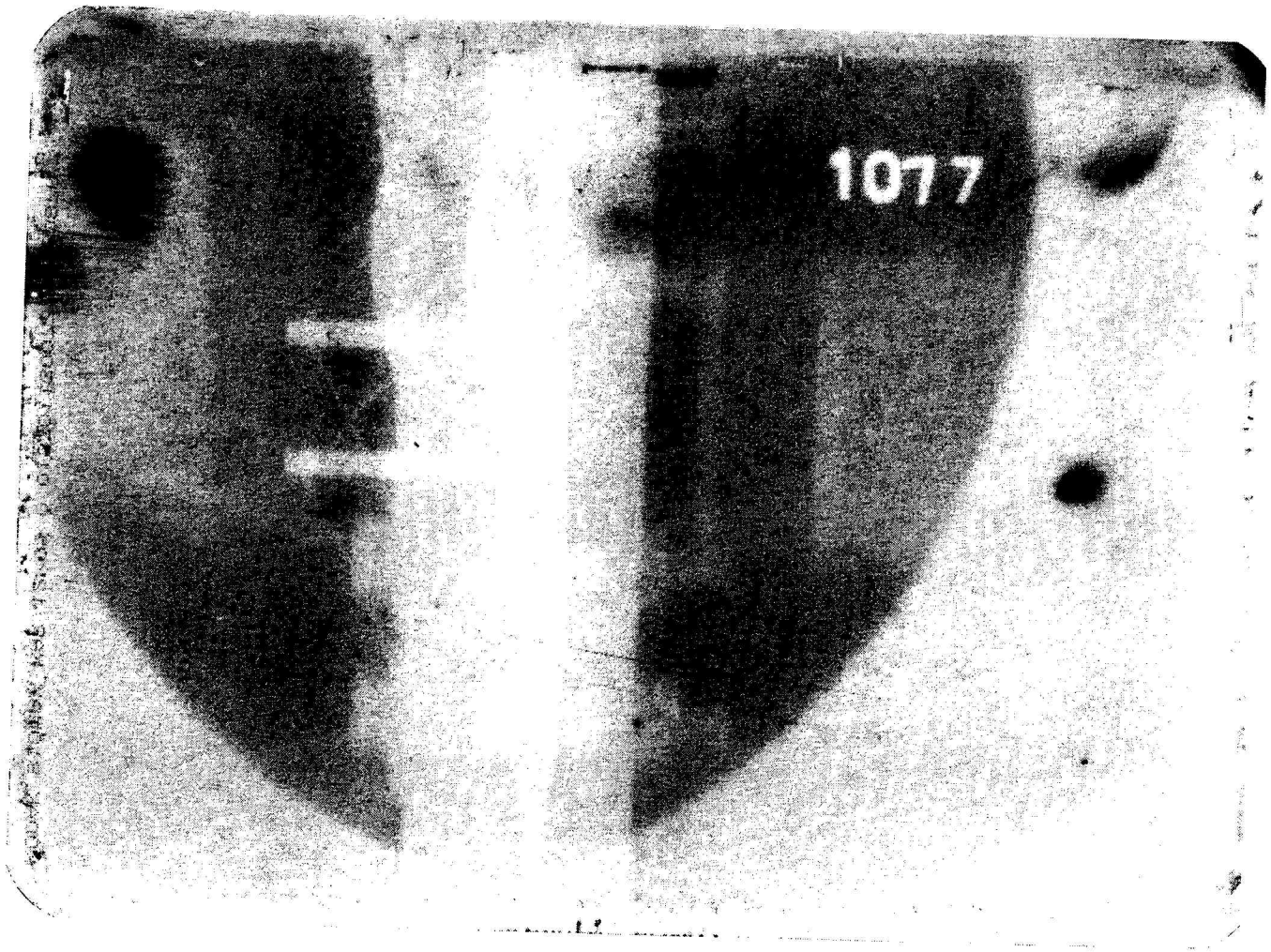

hp
HORIZONTAL
4.00 us/div
100 ns/div
delay
-1.000 us
-20.00000 us
reference
left cntr right
repetitive
realtime
sequential
off on
record length
32768
auto adjust
10 MSa/s
sample clock
c3
c12
c2
-1.000 us
19.000 us
39.000 us
4.00 us/div
realtime
y2(2) 2.03125 V
y1(3) -250.000 mV
delta y 2.28125 V
x2(2) 29.8356 us
x1(3) 29.6820 us
delta x 153.600 ns
1/delta x 6.51042 MHz

PRINTED : Feb-14-2012 12:27:17
PRODUCT : Classic 6500 S/N 849000024



TRC3M:
Feb-14-2012 11:58:15
500mV/div,100µs/div
TRC4M:
Feb-14-2012 11:58:15
200mV/div,100µs/div
TRC2M:
Feb-14-2012 11:58:15
200mV/div,100µs/div
TRC1M:
Feb-14-2012 11:58:15
500mV/div,100µs/div

TRIM
CURSOR : TRC2 -1.07V
+313.5995µs
CURSOR : TRC1 +7.50mV
+313.5995µs


1077